# AMERICAN MACHINIST

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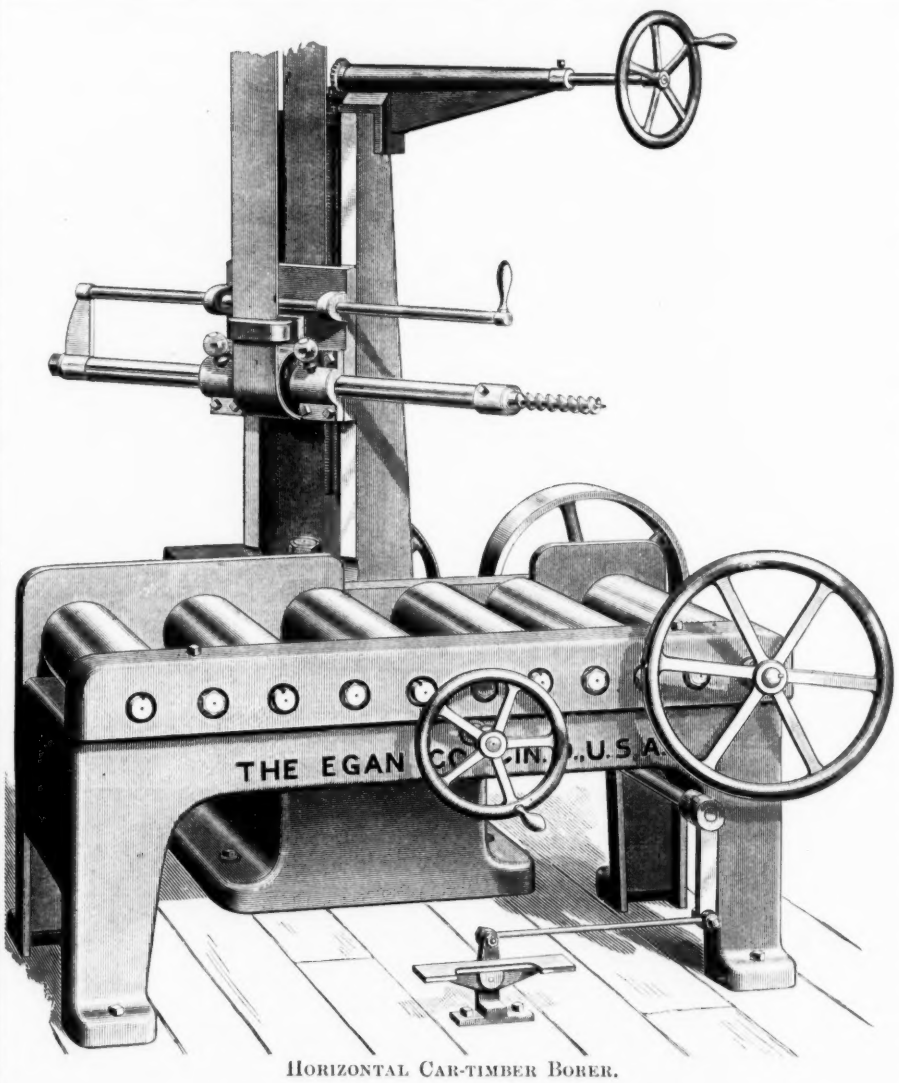
## Horizontal Car-timber Borer.

We present with this an illustration of a machine which has been designed especially for boring timbers used in railway car construction, and it is so arranged that a timber can be placed upon the rollers and moved along either by hand or power, while the bit can be placed in any position and be made to bore at any desired angle.

The machine consists essentially of a bed in which are placed six 6″ rollers as shown, upon which rests the timber to be bored. By a friction gear controlled by the foot treadle seen in front, these rolls are driven by power, thus moving the timber along to any desired position, the hand-wheel shown giving the hand movement. The frame supporting these rollers is bolted to a pedestal which supports a column to which is fitted a carriage carrying the boring spindle. This carriage is traversed vertically 26″ by means of the screw worked by the hand-wheel shown at the top of the machine, while the spindle has a traverse through its bearings, or to and from the work, of 24″, which is effected by the means indicated in the engraving.

The column swivels in a horizontal plane with its center of motion coinciding with the center of the driving pulley. The countershaft is placed above and is provided with a new device which keeps the belt always in proper position and in uniform tension in any position.

The machine is manufactured by The Egan Co., 239 to 259 West Front street, Cincinnati, O.



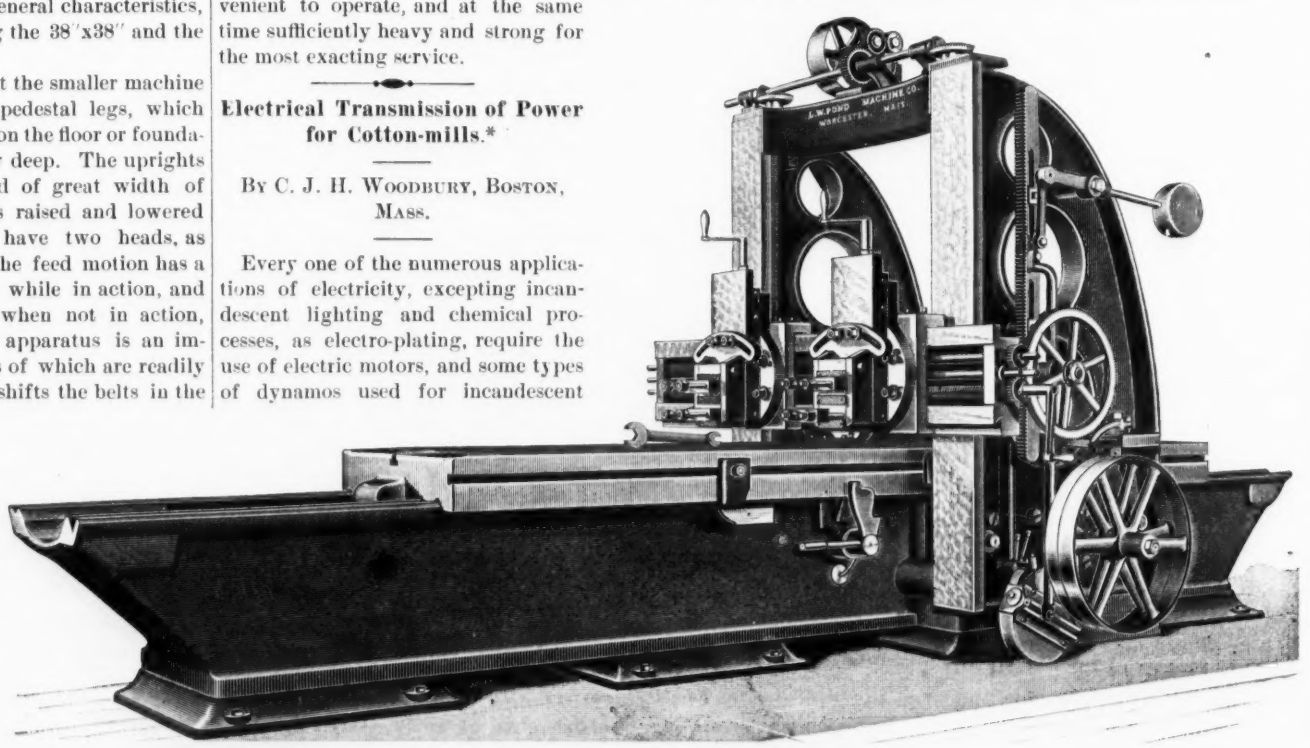

HORIZONTAL CAR-TIMBER BORER.

## Some New Planers.

We present with this, engravings (pages 1 and 2) of two sizes of planers which are representative of a new line of planers which have been brought out by the L. W. Pond Machine Co., of Worcester, Mass. These planers range in capacity from 22″x22″ to 72″x72″, but all have the same general characteristics, our engravings showing the 38″x38″ and the 60″x60″ sizes.

It will be noticed that the smaller machine rests upon very short pedestal legs, which give a large bearing upon the floor or foundation, the bed being very deep. The uprights are also very deep, and of great width of face. The cross rail is raised and lowered by power, and may have two heads, as shown, or only one. The feed motion has a great range, is positive while in action, and runs without friction when not in action, while the belt-shifting apparatus is an improved device, all parts of which are readily accessible, and which shifts the belts in the approved manner now considered essential on all first-class machines of this character.

The larger machine, it will be noticed, rests directly upon the foundation, and is fitted with side heads upon the housings, which have automatic vertical feeds. The beds of these planers are thoroughly cross-tied by webs, and the driving mechanism is arranged after the most approved plan, and gives a relatively high belt speed. In designing these planers the effort has been to secure machines convenient to operate, and at the same time sufficiently heavy and strong for the most exacting service.




NEW PLANERS.—SEE PAGE 2.

## Electrical Transmission of Power for Cotton-mills.*

BY C. J. H. WOODBURY, BOSTON, MASS.

Every one of the numerous applications of electricity, excepting incandescent lighting and chemical processes, as electro-plating, require the use of electric motors, and some types of dynamos used for incandescent electric lighting contain a regulator which is operated by a motor.

The telegraph receiver is a motor in which the electric impulses produced by the work at the operator's hands at the sending key converts the electricity from the batteries into work. In like manner, electric bells, watchmen's record clocks, railway signals, fire alarms, and even telephones, all are examples of motors. Mr. Edison once exhibited to me a telephone, in which a small rod attached to the diaphragm of the receiving telephone was fitted with mechanism by which its rapid longitudinal vibration was converted into circular motion, causing a tiny wheel to revolve very rapidly.

The experiments of Barlow in 1826, by which an electro-magnet was used to cause a continuous revolution, gave rise to many ingenious inventions of devices for producing rotary motions by electricity, some of the experiments being on a large scale; so extensive, indeed, that a yacht was propelled by one fifty-four years ago, and a railway car forty-one years ago.

All of these used the alternate attraction and release of an electro-magnet giving a reciprocating motion to an armature, and this was easily converted into rotary motion, and these devices obtained their electricity from batteries and were comparable as a matter of principle to a device which might be made by attaching a tiny connecting rod and crank to a telegraph receiver. None of these early electric motors were of any practical value whatsoever in serving for motive power.

The electric motor, which is the live issue of to-day, is based on the principle that, while a dynamo will generate electricity if power is applied to revolve the armature, yet, on the other hand, if electricity is applied to the dynamo the armature will revolve. The machine is reversible, and this reversibilty has been wisely called by that eminent mechanician, the late Clerk Maxwell, the greatest invention of the century.

It undoubtedly resulted, as far as public attention was ever called to the matter, from a blunder of a workman engaged in putting up some electric lighting apparatus at the Vienna Exhibition in 1873, by which the wires were connected to one dynamo at one end, and another dynamo at the other end, and when one dynamo was started, to the surprise of all, the other was set into rapid motion.

As is usually the case with such inventions, there are others who allege that this well-attested incident was the result of design to illustrate the discovery which they claim to have made previously.

It has been recently found that Dr. Antonio Pacinotti, the inventor of a magneto electric machine, wrote

*Abstract of a paper read before the New England Cotton Manufacturers Association.

a description of his machine in an Italian periodical in June, 1864, in which he says that it can be used to generate electricity, or as a motor, and he therefore is entitled to the credit for the invention of the present electric motor.

The same machine can and has frequently been used at various times for a dynamo for electric lights, and at other times for a motor, but there are numerous mechanical and electrical modifications essential to obtain the best results in an electric motor. The first use of an electric motor in any of the cotton-mills represented in this association occurred in a thread-mill in Newark, where a dynamo was used in 1882 as a motor to run a lot of thread-winding machines.

Electric motors are now used for hundreds of purposes, but this paper will be confined to references to their uses in cotton mills.

Electric motors are frequently proportioned to use low pressure currents of electricity like those employed for direct incandescent lighting.

There are many places where motors can be operated by wires from any of the direct incandescent lighting dynamos, but if the power required for the motor is more than about one-fifth that required to keep the whole number of lamps lighted, the lights will rise and fall in brilliancy like those in an electric car when the motor starts and stops, and the lighting service be unsatisfactory, and the life of the lamps diminished.

The problem is one which must be worked out in each case; sometimes when a small motor is required for use at short intervals during the day, it might be the more economical to use conductors from a large dynamo, which is already installed for lighting the mill at other times. If constant service is required from the motor, then a separate generating dynamo is advisable, and it may be said that in the generality of work it is preferable to put in a generator suitable for furnishing the current to the motors.

The principle holds as good in electric apparatus as in all other machinery, that more satisfactory results are obtained when there is no attempt made to require a more varied service from any machine than it is fully adequate to furnish.

It is generally advisable to use electricity for the transmission of power at a much higher pressure than that found best suited to incandescent lamps, because there is a great saving in copper for conductors, and a lesser proportion of the electricity absorbed by the resistance of the wires.

The current of 500 volts pressure used for the trolley system of street car propulsion is not capable of inflicting serious injury on mankind, although frequently fatal to horses. There have been motors suited for use on arc lighting circuits, but I believe that at the present time there are none of them on the market.

Before deciding to install an electric power plant for a service outside of what is already fixed by precedent, expense, delays and disappointment may be avoided by deciding how much you are willing to experiment, and secondly, how much the party doing the work must experiment, before the whole installation is in a practical operating condition.

The fact should not be lost sight of that electricity is merely a substitute for other methods of transmission of power; it has its losses at every step in the course comparable with those of the wear and tear and friction of shafting and belting. Like them, it also costs money, requires attendance, and wears out. It does not in any detail give something for nothing, but the results in comparison with other mechanical means of the transmission of power are merely the addition of a lot of differences; sometimes these differences are on one side of the account, and sometimes on the other.

An installation of motors in one instance may be extremely economical, and in another highly expensive, in comparison to ordinary methods of transmission of power.

Electric motors, like water-wheels or steam engines, have their highest efficiency at a point near to their full proper load, and on either side their efficiency in the percentage of electricity converted into work is diminished. The practical operation of some motors has been improved by the use of fly-wheels.

In its application for mill service, the most simple uses are those requiring a variable speed and direction, largely on account of causes outside of the electrical conditions in the construction of such motors. It is especially advantageous for elevators in storehouses or other buildings not requiring power elsewhere. A motor can be attached to any elevator machinery operated by a belt, and the elevator car managed in the same manner as before, so that the men have nothing either to learn or to forget. The first motor used for operating an elevator in a cotton-mill storehouse was placed in that service in 1882, and is in as good working condition to-day. Another use, having a larger field, is in its application for railways in mill yards and buildings. The Salmon Falls Manufacturing Company has 2,100 feet of track in the mill yard, and is operating a trolley system of cars to move all their cotton, supplies, cloth and coal with two men, thereby dispensing with the services of a team and three men all of the time, and a fourth man a part of the time. The car makes an average speed of 600 feet per minute, and is always ready for service whenever the water-wheel is running. Other mills use electric railroads from the cloth room to the storehouse with even greater reduction in cost of moving the load. There are two systems of overhead trolley propulsion. The ordinary single overhead wire, with the current returning through the wheels to the rails, and thence back through the earth to the dynamo, is the simplest and the only one that has a practical system of switches in the wires overhead. This system contains a serious objection in the electric sparks constantly occurring in the contact of the wheels with the rails, and liable to ignite any combustible there, and therefore could not be safely used inside of mills. For inside use it is necessary to use the double overhead wire system, by which the circuit is made between the two wires, without using the rails as conductors. In either case, the overhead wires should be thoroughly protected by guard wires whenever there is a possibility of telephone or other wires falling upon them.

Electricity is filling a most useful purpose in operating traveling cranes, and the few storehouses in mills which are provided with traveling cranes use them at such infrequent intervals that it is probable that hand-power is still the cheapest method of operation, but for erecting shops and other places where constant service is required, electricity affords great advantages for working such cranes.

Motors have been applied to calico printing machines with great success. The absence of heat, small amount of space, little momentum of the revolving parts, and the control by which the machine can be uniformly moved in either direction at any desired speed, are all advantages of the highest practical value.

Other classes of work require that the motor should revolve at as uniform speed as can be obtained by water wheel, or better, if possible. Motors will revolve at a constant speed if furnished with a current of uniform pressure. A compound generator will produce a current at a uniform pressure with variations in the load or quantity of current required by the motors; and it will also, to some extent, compensate for slight variations in the speed at which it is driven; therefore it may be said that the speed of an electric motor may be more uniform than that of the water-wheel or engine from which it derives the power which it gives forth.

A variation in lights is not a direct measure of variation in a dynamo, because a change of one per cent. in the pressure of the electricity in an incandescent lighting system would cause a variation of several per cent. in the amount of light from the incandescent lamps.

The class of service for the distribution of power throughout a mill, as a substitute for belt or rope transmission, has not been tried in cotton-mills, but there are many cases where it has been tried in machine shops, and yielded excellent results. The amount of power required in cotton-mills is so much greater than in machine shops, that the subdivision should be to a smaller unit than a whole room in a large mill.

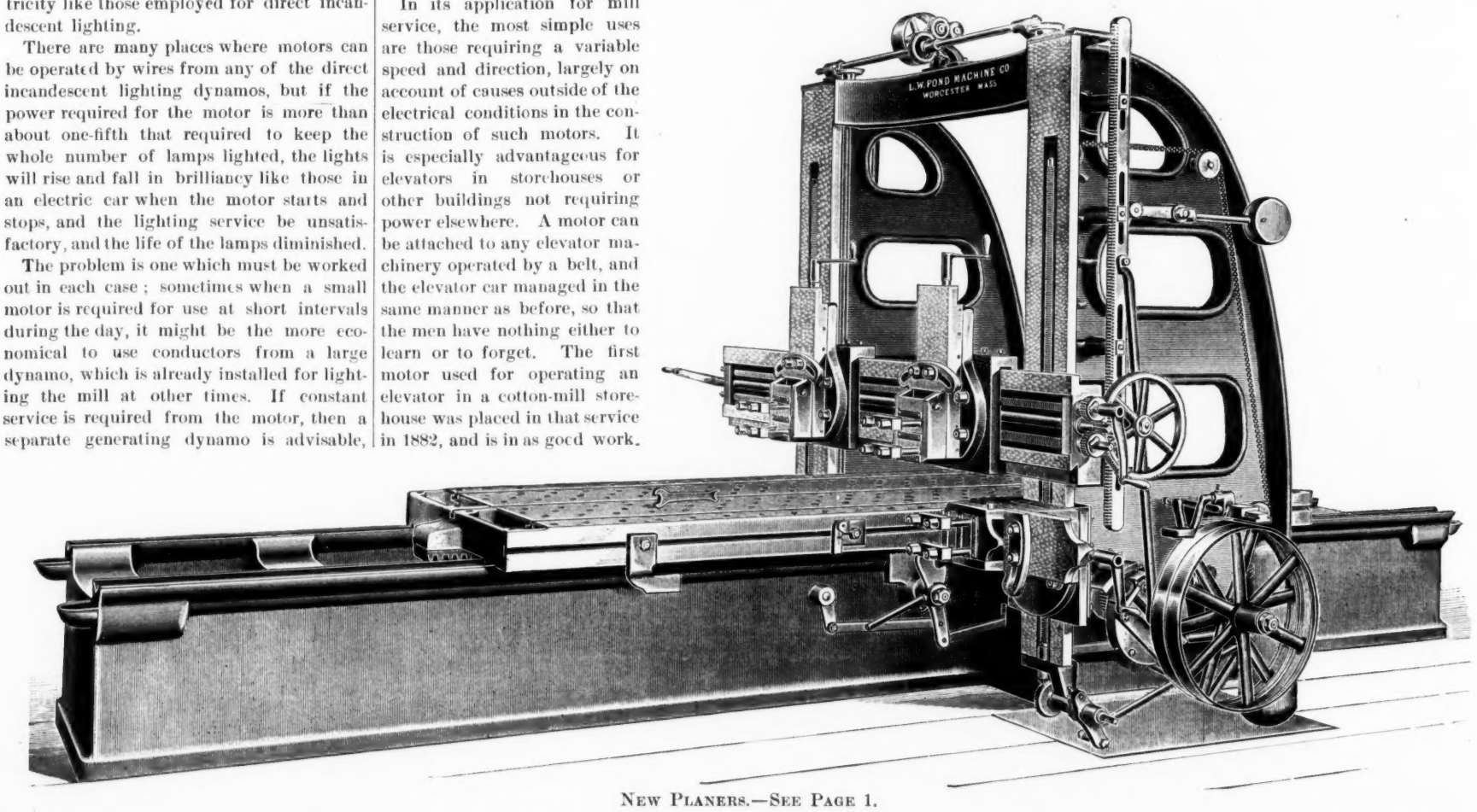
I am convinced that such a distribution of power is mechanically feasible; but will it pay to do so when motors and generators each cost nearly or quite $40 per horse-power, or, including wire and foundations, over $100 for every horse-power transmitted?

Another class of applications consists in distributing the electricity from a central station in a mill yard to the various buildings

The most complete plant of this kind is at the Edison Works at Schenectady, where 1,700 horse-power are electrically distributed to numerous shops situated at various places in a tract some twenty acres in extent.

The Thomson-Houston Works at Lynn have an extensive electrical distribution of power in their present works, and will have a larger power plant when their new works are completed.

At the Cumberland mills in Maine 260 horse-power is transmitted by the Mather electric system over a mile, and motors are used to drive paper machinery, giving from poorly governed water-wheels a sufficiently steady motion for calendars, but the compensation by the compound wound generators is not sufficient to remove the effect of all the variations of speed in the water-wheels from appearing in the motors, and these motors cannot run Fourdrinier paper machines, although motors in these mills—deriving their power originally from a steam engine—perform satisfactory work in driving paper machines.




NEW PLANERS.—SEE PAGE 1.

At these same mills an installation of motors is under way for the transmission of 1,200 to 2,000 horse-power for a distance of seven miles.

As water-wheels give sufficiently uniform speed for looms, and as motors do give a more uniform speed, there is but little question as to their mechanical suitability for such work.

The third class of applications for electric motors is in connection with long distance transmission of power for the purpose of bringing the energy of a water privilege to a locality more convenient for manufacturing.

The problems of short distance transmission already considered are as different from those involved in the transmission for a long distance as river navigation differs from that on the ocean; and the extent to which these long-distance problems have been mastered was shown by the transmission of 300 horse power 109 miles through No. 6 wire, at the Frankfort Exhibition in Germany last year. There are power transmissions in California for mining machinery for long distances, some of them being twenty-seven miles, but I am not aware that any such great distance has been applied for driving textile machinery.

The electric lighting and power used in Hartford, Conn., is derived in part from a water-power at Tariffville, and some 300 horse-power are transmitted along the wire that distance.

The Nanatuck Silk Company are supplying to their mills at Leeds and Haydenville, power transmitted by electricity from a dam

in a rocky gorge in the river, about a third of a mile from one mill, and a mile and three-quarters from the other.

The installation is not cited as being on a large scale, but because it contains many ingenious features in the manner in which the motors are applied as an auxiliary and regulator to the water-wheels.

The fall of thirty feet is situated between banks, where it would not be developed under ordinary conditions, because the spot is unsuitable for the location of a mill.

There are two water-wheels in use. One of 100 horse-power drives dynamos which furnish 950 incandescent lamps on an alternating system at the mills. The other water-wheel drives one Thomson-Houston generator of 85 horse-power and another of 30 horse-power, the pressure of the current being the same as that used on trolley street cars. At the mills, one-third of a mile distant, is one motor of 45 horse-power, two of 20 horse-power, and one of 10 horse-power, all supplied by electricity from the 85 horse-power generator.

The 45 horse-power motor belts upon the main shaft, which is driven by two water-wheels having a capacity of 100 horse-power under a 12½-foot fall.

The water-wheels are run at full gate without any regulator, but the motor serves as a regulator running at uniform speed, and furnishing the remainder of the power, which has a variable range of 25 horse-power.

When the water falls too low for the water-wheels and motor to run the mill, a steam engine is belted to the main shaft, the motor and water-wheels furnishing their full capacity, and under these conditions the engine regulates the speed of the whole. It is an important precaution to set the governor on the engine for a speed slightly greater than its proportion to the other motor and water-wheels, so that it will lead, and also to prevent the motor from tending to do more than its proper capacity.

The other three motors are used to drive the machinery in an adjoining mill building, and they are connected directly to the shafting, one in each room.

The 50 horse-power generator at the power station operates a 45 horse-power motor in the mill at Haydenville, a mile and three-quarters distant.

The arrangement of motor, turbines and engine is the same as at the lower factory, but placed in a more compact manner.

Arrangements are being made for an increase of this electric plant, and Mr. Dimock, the managing director, sends me word that he will be pleased to show this electric power installation to any textile manufacturers.

For long distances it is essential to use electricity at high pressure, in order to avoid the necessity of using large wire.

For this purpose the electricity is generated in pulsations known as multiphase currents, at great pressure, and, before entering the building where the motors are situated, the electrical pressure is reduced by a transformer, and in that condition used by the motors. Mr. Nikola Tesla, of the Westinghouse Company, is the inventor of this type of motors, which have been in practical use for some time in the shops of the Westinghouse Company at Pittsburgh.

It is this type of multiphase machines which offers the only feasible means for transmission over distances exceeding a very few miles, without such undue losses as to be out of the question. These motors, being free from commutators or brushes, do not spark, are very compact, and easily start under full load.

Motors using multiphase currents are under construction by the General Electric Company.

There are several places in New England where the power of waterfalls is being applied through electrical apparatus to machinery at a distance, and there are numerous extensive enterprises of this nature under construction.

The electric transmission of power under any practicable conditions of constant or variable speed at a loss not exceeding twenty per cent. has been shown to be entirely practicable, and the open question in regard to all of these devices, whatever may be their purpose, is the question of cost.

It was my privilege, at a meeting of this association held ten years ago, to present a paper on the subject of Electric Lighting in Mills.

The applications of electric illumination have grown during these ten years to such an extent that the daily manufacture of incandescent lamps in this country is now three times the whole number of incandescent lamps then in use in the country, and I believe that there is no reason to question why there will not be in this decade a comparable increase in the applications of electricity to the transmission of power.

A correspondent asks for the address of "Albron," whose communication appeared in a recent issue. We are not able at this time to give his address, but if he has no objection to its publication shall be pleased to give it.

The Japanese Government contemplates the construction of six lines of railway aggregating 800 miles in length. The purchase of the private railways by the State is also projected.

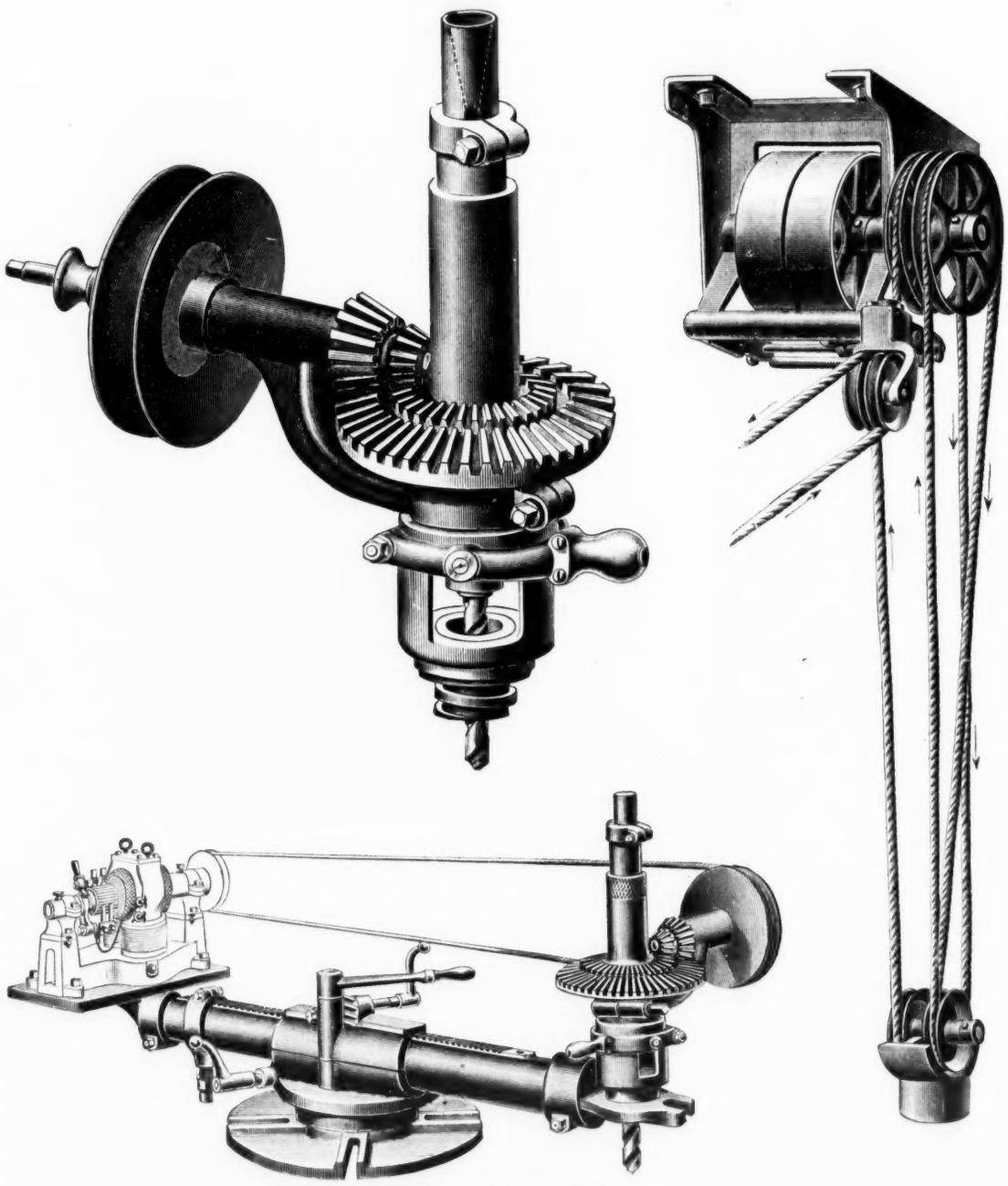
## Improved Portable Drill.

In our issue of January 31, '89, we illustrated and described a portable drilling machine devised by Mr. James T. Halsey. Since that time this drill in various forms has been introduced into very many machine and boiler shops, and it is now regularly manufactured by Mr. Halsey, at Twenty-sixth and Callowhill streets, Philadelphia, Pa.

We present herewith some illustrations showing some of the latest forms of this machine, and it will be noticed that there is now a clutch added by which the machine is more readily handled and its efficiency increased. One of the engravings shows the machine as arranged to be driven by an electric motor which is placed at the opposite end of a cylindrical bar, which may be traversed through the clamping plate by means of the rack and pinion movement shown.

We give also a view of the countershaft which is used when the machine is to be driven by a rope, and it will be noticed that this is so arranged that the tension on the rope is always kept uniform, and the drill may be used at any desired distance from the countershaft or in any desired position. When preferred, a cone pulley is supplied in place of the plain grooved pulley shown.

It will be remembered that the smaller pair of beveled gears which operate within the larger ones are for the automatic feed, the ratio of these being slightly different from the driving gears, so that a threaded sleeve from which the feed is obtained is rotated at a slightly different rate from that of the spindle. By loosening one clamping screw the spindle may be taken out of the machine and reversed if desired, both ends being bored for Morse taper shank tools.



IMPROVED PORTABLE DRILL.

*The Tradesman*, Chattanooga, Tenn., offers a reward of $75 in gold for the best essay on what line of manufacture will pay best in the South. There is an opportunity to make some money here, and we have no doubt our contemporary will find that it has provided for crowding its columns with suggestions.

## Another English Invention.

A friend sends us an item cut from the *Manufacturers' Gazette*, which reads as follows:

The difficulty of securing a perfectly sound and tight joint in pipes is said to have been overcome by an English firm by adopting conical threads. These readily adapt themselves to any slight inequality in the tubes, which can be screwed up much more tightly than with the ordinary threads. Machines are being made with dies especially designed for cutting the conical threads, and so arranged that the full thread is obtained at one screwing.

Regarding this, he inquires: "Do you see anything funny about this?" In view of the fact that this item appears in a paper which might be supposed to know at least something of pipe threads; that there is such a thing as the Briggs Standard; that this calls for a taper, or what is here referred to as a conical thread, and that pipes are almost always cut by dies at a single cut, we do see something quite amusing in this item.

## A Confederate Patent.

Of the many people who think they know a good deal about the Confederate government, only a few are aware of the fact that the Confederacy was supplied with a patent office and that it issued patents in just about the same style as that practiced by the United States. How many inventions received such protection as could be thrown around them by the power which ruled the South for four years may never be known, but it is certain that at least fifteen received official recognition, for, on a wall in the office of Mr. James L. Norris is an original document which assured John L. Jones, of Tally-Ho, North Carolina, that for fourteen years from the 26th day of August, 1861, he should have "the full and exclusive right and liberty of making, constructing, using, and vending to others to be used," a new and useful improvement in carriage wheels. This was the fifteenth patent issued by the Confederacy. It was signed by Judah P. Benjamin, Attorney-General, countersigned by Rufus R. Rhodes, Commissioner of Patents. Mr. Rhodes was United States Commissioner of Patents prior to the war.

Accompanying the parchment, which is properly sealed, and which cost Mr. Jones the sum of $40, are the customary specifications and drawings. The penmanship displayed in the specifications is extremely beautiful, while the drawings, which are in India ink on linen tracing, could hardly be improved on. The whole forms a most interesting and valuable souvenir.—*Washington Star.*

It appears probable that iron sleepers will in due time be used on an extensive scale in Austria. The State Railways Administration, it is reported, has contracted with the syndicated Austrian rail-mills for a large supply of metal sleepers at a price but slightly inferior to that paid for steel rails, with the proviso, however, that a lower rate is to be accepted should the demand exceed 25,000 tons. It is stated, moreover, that the Southern Railway is inviting tenders for the supply of 35,000 iron sleepers.

### The Comstock Pipe Cutter.

We present with this an engraving of a new pipe cutter, the construction of which will be readily understood. It belongs to that class of cutters in which a cutting roller is used, and the well known tendency of these rollers to throw up a bothersome burr on the outside of the pipe is overcome by placing opposite it steel cutters, as shown, the face of these coming up even with the surfaces upon which the pipe rests, and thus removing all burr as fast as formed. The tool is made entirely from drop forged steel, and the roller can easily be changed by means of a screw-driver. The cutters for removing the burr are formed in the hardened steel bearing pieces shown, and both these pieces are secured in place by a single key made from steel wire. The upper engraving shows a piece of pipe, one end of which was cut by the ordinary and the other by this improved cutter which is made, by H. Comstock & Co., Fulton, N. Y.

THE COMSTOCK PIPE CUTTER.

### Notes on Rope Driving—I.

BY M. E.

During the last decade a considerable amount of attention has been given to the transmission of power by means of cotton, hemp or manila ropes, and in England at the present time multiple rope driving has to a very large extent displaced other systems of transmission wherever large amounts of power have to be dealt with and a fairly high velocity of transmission is permissible. Probably one of the purposes for which rope driving is most especially suitable is the distribution of power in cotton-mills, and so successful has the system proved that in almost all the mills erected during recent years in Great Britain, on the continent of Europe or in India, rope transmission has been adopted for the main driving, and in many cases for first motion connection also. Nor is it very difficult to account for this marked preference for rope transmission over gears. In the first place, that all important factor—the cost—is considerably less. Then again for flexibility of connection and facility in distributing power, rope driving certainly leaves little to be desired, while changes in the amount of power transmitted can be readily effected, and at a cost which is absolutely insignificant in comparison with the alterations required to effect a similar modification when gearing is used. Of course a large rope, race or well, occupies a considerable amount of space in the mill building—frequently, indeed, far more than is necessary—but it is not a very expensive provision if made at the time of the erection of the building, and it must not be forgotten that the absence of the troublesome vertical shaft, with its series of bevel gears, has to be set against this item.

Notwithstanding the many advantages possessed by this system of power transmission, however, it is generally admitted that the efficiency of rope driving by independent ropes is about 10 per cent. less than that of well-made and carefully-erected spur gearing. This loss of power is chiefly due to (1) resistance of ropes to bending; (2) absorption of power by the ropes entering and leaving the grooves; (3) "elastic" slip or "creep"; (4) differential driving effect when two or more ropes are used; and (5) increased journal friction due to the pull of the ropes and to the employment of abnormally heavy rope driving fly-wheels, etc. These losses we will now briefly investigate.

(1) *Loss due to Resistance to Bending.*—Various formulas for the resistance of ropes to bending stress have been proposed from time to time, but it is obvious that the conditions may vary considerably in different installations. The degree of twist put into the rope is undoubtedly an important factor in this connection; for, although hard-twisted ropes are decidedly stronger than those loosely twisted, the internal wear is much greater and the life of the rope is considerably less than with the latter. The importance of lubricating the core and internal fibers is now generally recognized, and all the better classes of ropes are laid in tallow or a mixture of tallow and plumbago, which greatly reduces the resistance to bending and correspondingly increases the durability of the rope. This resistance is also influenced by the arc of contact with the pulley, by the tensions on the two sides of the rope, and probably to a slight extent by the angle of the V grooves. All that can be said positively on the subject is that the resistance to bending of a rope varies inversely as the diameter of the pulley over which it passes, and that it increases with the diameter of the rope in some ratio yet to be exactly determined. In Eytelwein's formula for the stiffness of hemp ropes the resistance to bending is taken as varying with the square of the rope diameter, which appears reasonable. In Columb's formula, however, the 1.7th power appears. With regard to the diameter of the pulleys to be used it may be said that, under ordinary circumstances, the minimum diameter should not be less than that given by the well-known rule, viz.: 30 rope diameters, and if in any case it is absolutely necessary to use a smaller pulley, a very lightly-twisted rope should be used and the load upon it reduced. With the smaller sizes of ropes the minimum pulley diameter *may* be somewhat less than that given by the above rule, but for ropes above 1½ inches in diameter the 30-diameter limit should certainly not be overstepped. In the absence of reliable data on the subject it is impossible to formulate a satisfactory rule for the loss due to bending. Various estimates place it between 2 and 12 per cent., but in ordinary cases and with fair-sized pulleys about 3 per cent. should cover the loss from this cause. Finally it should not be forgotten that this loss can be mitigated very considerably by keeping the ropes in a soft and pliable condition.

*Loss due to Rope entering and leaving the Grooves.*—Considerable difference of opinion exists as to the extent of the loss due to the resistance encountered by the rope in entering and leaving the groove. It is certainly made the most of by the belting man, who here sees an opportunity of disparaging the newer system of transmission, possibly often to his own advantage. It is obvious that the extent of this loss must vary considerably under different conditions of service. The chief factors are: Tension on the driving and slack sides of the rope, the angle of the groove, the velocity of the ropes, and generally the condition of the latter and of the grooves.

The tension on the driving side is dependent upon the amount of power transmitted, the speed and the centrifugal tension; the slack side tension is influenced by the length of the drive and the amount of "sag" allowed, together with the centrifugal tension in the rope.

Frequently the slack side tension is abnormally high, and as a consequence the rope is severely wedged into the groove, and rapid wear and loss of power results. As to the best angle for the groove in the pulley, opinion is still somewhat divided, but in England the general practice seems to favor an angle of 45° as the most suitable; occasionally, however, more acute and sometimes more obtuse angles are met with. The object is, of course, to select an angle which will afford the best compromise between slipping of the rope in the groove on the one hand (entailing friction, loss of power and imperfect driving), and excessive wedging of the rope in the groove (absorbing power) on the other. In extreme cases in either direction the wear of the rope is abnormally high and its life correspondingly reduced.

For dry cotton or hemp ropes working on cast-iron pulleys the coefficient of friction is about 0.28, but as the ropes are always in a more or less greasy condition a coefficient of 0.20 may be taken as representing a reasonable value in practical working. For a rope running in a V groove, however, this coefficient is to be multiplied by the cosecant of half the angle of the groove, so that for an angle of 45° the coefficient of friction virtually becomes

$$0.20 \times \textit{cosec.}\ \frac{45}{2} = 0.20 \times 2.613 = .5226.$$

Usually the same angle of groove is adopted in both driving and driven pulleys, but sometimes—more especially when there is a considerable difference in the pulley diameters—dissimilar angles are employed. The object of this arrangement is to equalize the frictional grip of the rope on the two pulleys. This grip depends upon the arc of contact of the rope with the pulley, and upon the coefficient of friction and the angle of the groove, as already explained. Thus, if the coefficient be taken as the same for both pulleys then

$$\textit{cosec.}\ \frac{a_1}{2}\ \Theta_1 = \textit{cosec.}\ \frac{a_2}{2}\ \Theta_2$$

$\Theta_1$ and $\Theta_2$ being the arcs of contact of the rope with the large and small pulleys respectively; $a_1$ the angle of the groove in the large, and $a_2$ that in the small pulley. Calculations of this kind are considerably simplified by the aid of such a graphic diagram as is shown in Fig. 1, in which a series of four friction spirals is drawn corresponding to grooves of 35°, 40°, 45° and 50° respectively, and assuming a normal coefficient of friction $f_1$ of 0.20. As with suitable modification the principle is equally applicable to belts, a brief description of the method of constructing these friction curves may be of interest.

The circle $A\ C\ R$ is taken to represent the "pitch diameter" of a grooved rope pulley, and is conveniently divided by a series of equidistant radii into sectors of 30°, as shown. Then if $t$ is the tension in the slack side of the rope, and $T$ that on the driving side, it is capable of proof that

$$\textit{log.}\ \frac{T}{t} = 0.00758 \times \textit{cosec.}\ \frac{a}{2}\ f\ \Theta$$

Taking $t = 1$; $a = 45°$; $f = 0.20$, and $\Theta = 30°$, we have

$$\textit{log.}\ T = 0.1186 \text{ and } t = 1.314.$$

Representing by the initial radius $O\ A$, the slack side tension $t = 1$, the length $O\ 1$ on the radius $O\ B = 1.314$, and setting off this length we obtain the point 1 on the curve. To obtain the lengths of the remaining radii of the spiral we proceed as follows: Join $A\ 1$, and with $O$ as center draw the arc $1\ b$. Draw $b\ 2$ parallel to $A\ 1$, describe the arc $2\ c$; draw $c\ 3$ parallel to $A\ 1$, and continue the process until sufficient points are obtained. Then make $O\ c' = O\ 2$; $O\ d' = O\ 3$, etc., and through the series of points thus obtained draw the logarithmic spiral $A\ d'\ g'$, as shown. The other curves corresponding to the various angles of grooves selected are constructed in a similar manner.

It will be evident from the method of construction of these curves that any radius of any spiral, as $O\ Q$ represents the tension on the driving side of the rope for the arc of contact $A\ C\ R$, and on the same scale that $O\ A$ or $O\ R$ represents the tension on the slack side, so that $Q\ R = T - t$, or the driving effort, which, multiplied by the velocity of the rope in feet per minute, gives the power transmitted. In order to illustrate the application of the diagram to our immediate purpose, *i. e.*, to ascertain the angles of grooves suitable for pulleys of different diameters for equality of driving effort—we will assume a case in which the relative diameters of the pulleys and the distance apart of their centers are such that the larger has a normal arc of contact $A\ C\ R$ of 210°, and therefore the smaller an arc $A\ C\ S$ of 150°. The power to be transmitted being divided by the velocity of the rope the driving effort is obtained, and this is then set off on the radius $O\ A$, and to the scale on which the length of $O\ A$ represents the slack side tension. Let $O\ V$ be the length representing the driving effort and draw a circle $V\ T\ Q\ P$. This cuts the radius $O\ R$ in $Q$ at the intersection therewith of the 50° groove curve. It also cuts the radius $O\ S$ (corresponding to the arc of contact of the small pulley) in $P$ and near the intersection therewith of the 35° groove curve. It is therefore clear that a groove having an included angle of 50° may be used for the large pulley, while 35° will be suitable for the small pulley, these giving equality of frictional grip in the particular case selected.

Considering two rope pulleys of equal size, $A$ and $B$, Fig. 2, of which $A$ is the driver, it will be seen that the pressure forcing the rope into the groove varies throughout the semi-circumference of each pulley. Thus if $T$ be the driving tension on the lower side of the rope, and $t$ the slack side tension, then it is clear that the tension will increase from $t$ pounds at $m$ to $T$ pounds at $n$, and the rope will in consequence be forced deeper into the groove as the point $n$ is approached. At this point the work of disengaging the rope commences, and if the groove is at all acute it will "hug" the pulley for a short distance, as indicated at $P$, before it is ultimately released. In the case of the driving pulley the conditions are somewhat different, as the rope enters the groove under the superior tension $T$, and is at once forced into the groove to the maximum depth. Probably at comparatively low speeds the rope remains in the groove of the driving pulley at a fairly uniform depth until disengagement occurs. It may be noted that when the lower is the driving side the weight of the rope assists its release from the driven wheel, but opposes its release from the driver. It would appear, however, that the work expended in overcoming the wedging of the rope in the groove is approximately the same in both cases.

At high speeds the centrifugal force of the rope as it passes round the pulley diminishes the wedging action to some extent, provided suitable allowance is made for centrifugal tension by proportionately reducing the power transmitted. Usually ropes are subjected to a maximum stress ($T_0$) of about 300 pounds per square inch, while for the slack side tension ($t_0$) a suitable allowance is 20 per cent. of $T_0$, or 60 pounds per square inch. We have therefore under such conditions $T_0 - t_0 = 300 - 60 = 240$ pounds working tension per square inch in the rope, and at low speeds practically the whole of this is available for power transmission. Referring again to $A$ (Fig. 2) it will be seen that the pressure by which the rope is drawn into the groove is the sum of the tensions $T + t$ which in the case in point will be 360 pounds. It has already been pointed out that the pressure varies throughout the arc of contact, but we may obtain a *mean* normal pressure per unit of length upon the semi-circumference of $A$ by dividing the sum of the tensions by the diameter of the pulley. Assuming the latter to be 3 feet we have $\frac{360}{36} = 10$ pounds *mean* normal pressure per inch of length throughout the arc of contact; but at high speeds the maximum tension $T$ must be diminished by the stress due to centrifugal action, and which is equal to $C = \frac{w\, v^2}{32.2}$; $w$ being the weight of 12 cubic inches of the rope, and $v$ its velocity in feet per second. Taking $v = 80$ feet per second, $C = \frac{0.408 \times 6{,}400}{32.2}$ = 81 pounds per square inch, as the stress per square inch in each side of the rope due to centrifugal action. As we have assumed the maximum stress $T_0$ is not to exceed 300 pounds per square inch, it is clear that the stress due to the transmission must now be reduced to $300 - 81 = 219$ pounds, while $t_0$ will now be $60 + 81 = 141$ pounds. The mean normal between the rope of the pulley is now apparently $\frac{300 + 141}{36} = 12.25$ lbs. per inch of length, but against this must be set the diminution of pressure due to the tendency of the rope to leave the groove in a radial direction. The amount of this radial effort per foot length of the rope is

$$F = \frac{w\, v^2}{32.2\ r} = \frac{0.408 \times 6{,}400}{32.2 \times 1.5} = 54 \text{ pounds}$$

per foot, or 4.5 pounds per inch of length. Deducting this from the apparent normal pressure we have $12.25 - 4.5 = 7.75$ pounds per inch of length as the net *mean* normal pressure throughout the arc of contact.

An abnormal degree of slack side tension has a direct effect upon the wedging of the rope in the groove, for if sufficient sag is not allowed, and the slack side tension is, therefore, needlessly great, it follows that (the tension on the driving side being constant) the power transmitted will be diminished, since $T - t$ becomes less, while the sum of the tensions $T + t$ drawing the rope into the groove is increased. It is evident from this that the slack side tension should, in all cases, be reduced to the smallest possible amount consistent with the prevention of slipping at the highest speed at which the ropes are to be run. It is the writer's firm belief that much more satisfactory results, both in general working and durability, would be obtained if a much smaller amount of slack side tension was allowed than is usual at the present time.

In order to calculate the amount of sag necessary to produce a predetermined degree of tension, the approximate formula

$$S = \frac{L^2\, w}{8\ T'}$$

is quite sufficiently accurate for the purpose. In this case, $S$ = sag of rope in feet, $L$ length of drive in feet, $T'$ the tension, and $w$ the weight per foot run of the rope. It will be found that with ordinary lengths of drive and moderately large pulleys the theoretical sag will not be inconveniently great. As an example, we will take a case somewhat similar to that given in the foregoing, and assume a length of drive of 60 feet, a speed of 80 feet per second, and a rope one square inch in area. Taking the tensions as above determined, we have for the sag on the tight side:

$$S_1 = \frac{3{,}600 \times 0.408}{8 \times 300} = 0.612 \text{ foot} = 7\ 34 \text{ inches.}$$

For the slack side tension we have:

$$S_{11} = \frac{3{,}600 \times 0.408}{8 \times 141} = 1.3 \text{ foot} = 15.6 \text{ inches.}$$

It may here be noted that when not transmitting power each side of the rope will have an "initial sag" of:

$$S_0 = \sqrt{\frac{S_1^2 + S_{11}^2}{2}} = \sqrt{\frac{.372 + 1.69}{2}} = 1.01 \text{ foot} = 12.12 \text{ inches.}$$

It should also be remarked that under the conditions assumed above, viz., that the total tight side tension $T_0$ remains constant, the sag on the tight side of the rope will also remain constant for any definite length of drive. On the other hand, since, as previously explained, the slack side tension increases with the speed, owing to centrifugal action, it will be seen that the sag of the slack side should be greater for lower speeds than for high. Thus, if in the previous example the speed is taken sufficiently low to enable centrifugal action to be disregarded, the sag of the slack side would require to be:

$$S = \frac{3{,}600 \times 0.408}{8 \times 60} = 3.05 \text{ feet.}$$

It will be noted that, if the length of drive is constant, the sag varies inversely as the tension, so that if one amount of sag is calculated from the tension of the corresponding side, any other sag may be at once determined if the tension is known. Similarly, if one tension is given, and the corresponding sag ascertained, any other tension can be readily arrived at. It will now be clear that by allowing the maximum amount of sag in all cases, the tension on the rope is reduced to a minimum under the given conditions, and, more important still, the pressure forcing the rope into the groove is also reduced to the least possible amount. In this connection it may be noted that, if in the foregoing example the rope is tightened until the "initial sag" on each side is 6 inches, the aggregate pressure forcing the rope into the groove will be increased from 441 to 943 pounds.

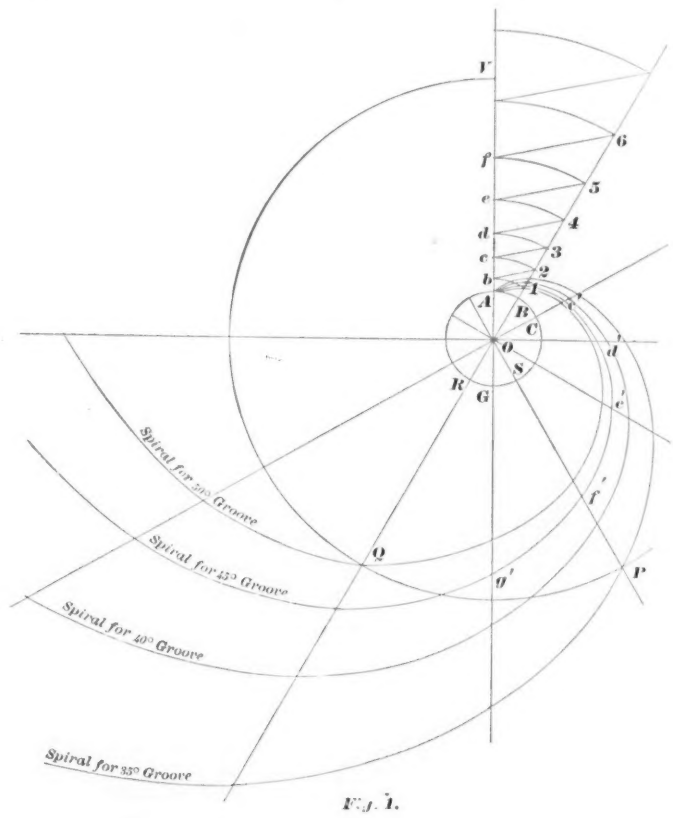



Fig. 1.

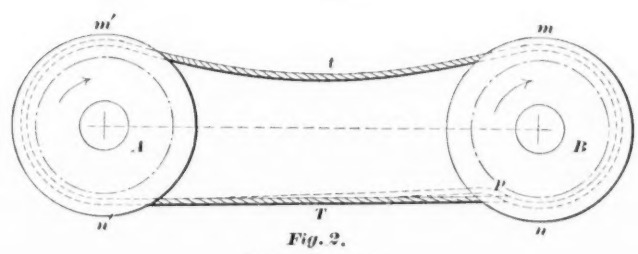



Fig. 2.

ROPE DRIVING.

*Loss due to Slip or Creep.*—The loss of velocity due to the "elastic slip" of the ropes reduces the efficiency of this system of power transmission to a small extent but with the best makes of cotton or hemp ropes the loss from this cause should not, in the opinion of the writer, exceed about two per cent. That a certain amount of loss must inevitably be incurred may be seen from the following considerations:

When the rope commences to transmit power, each foot length (as measured in the normal unstrained condition) of the driving side is increased in length to $1 + \frac{T}{E'}$ in which $T$ is the tension, and $E$ the modulus of elasticity of the material of which the rope is made. Similarly, each unit length on the slack side becomes $1 + \frac{t}{E}$ feet in length.

Referring now to Fig. 2, it will be seen that the velocity of the driving side $T$ of the rope is equal to the circumferential speed of the driving pulley $A$. As the rope passes round $A$, however, it is subjected to a gradually diminishing tension, and each unit length decreases, in consequence, from $1 + \frac{T}{E}$ at $n'$ to $1 + \frac{t}{E}$ at $m'$. It follows that the length of rope delivered at $m'$ is less than that received at $n'$ in a given time in the proportion $\frac{1 + \frac{t}{E}}{1 + \frac{T}{E}}$ and therefore the velocity of the slack side $t$, and consequently that of the driven pulley $B$, is correspondingly less than that of $T$. Taking $T$ and $t$ at 300 and 60 pounds respectively, and assuming the very moderate value of 30,000 pounds for the modulus of elasticity, we have

Vel. of pulley $A$ = vel. of pulley $B \times \frac{1 + \frac{60}{30{,}000}}{1 + \frac{300}{30{,}000}} = \text{" "} \times 0.992.$

So that in this case the theoretical loss is less than one per cent.

## LETTERS FROM PRACTICAL MEN.

### Steam Packing Rings.

*Editor American Machinist:*

It is understood by all that the first work performed by steam after entering a cylinder containing a piston whose rings are of the steam-operated type, is to expand the rings against the circular wall of the cylinder. Second, to move the piston.

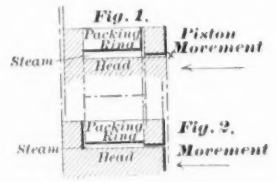
In Figs. 3, 4 and 5, $A$ represents the walls of a cylinder, $B\,B$ the piston heads, and $C$ the piston rods.

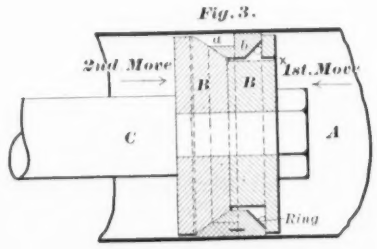
Figs. 1 and 2 illustrate steam ring packing in its simplest form. Steam entering the head through aperture $X$ expands ring, then moves the head closing the crevice (which always exists in a slight degree, even when new, to allow free action of the ring) on the right hand side of the ring, the head striking a hammer blow on the ring and opening it on the left side, as shown in Fig. 2, permitting the steam to blow through.

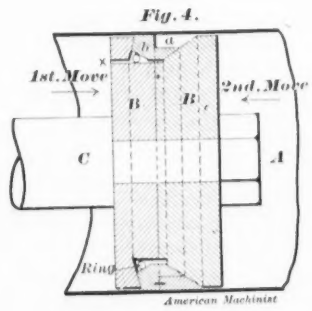
The steam blowing through, in addition to the hammer blows of the head, constantly tends to destroy the object sought for, and a leaky piston rapidly growing worse is the result, for which in practical mechanics there is no cure.

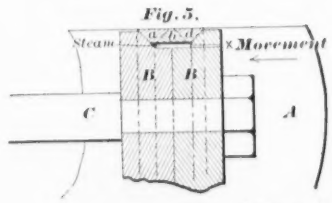
This type of packing can be made steam-tight when new only by accident, a looseness of one ten thousandth of an inch being enough to cause its destruction.

Fig. 3 illustrates the same type as shown in Figs. 1 and 2, only in a more complicated and aggravating form; the addition of the steel spring tends to wedge the rings until the steam pressure takes effect, when they give, under the same action as explained regarding Figs. 1 and 2. As the rings expand to meet the wear to the cylinder walls, the angular joint of the rings with the head opens wider than it does in the vertical, or




STEAM PACKING.

the joint between *a* and *b* widens to meet the existing conditions, or the joint between *a*, *b* and *B* widens as the length over all of *a* and *b* grows narrower from wear, and "the perfect steam-tight packing" is a thing of theory only. More so than in the simpler form shown in Figs. 1 and 2.

Fig. 4 shows the same type of packing, with an effort to overcome the tendency towards self-destruction by means of the reversed angle in the head on the left-hand side. In theory this looks good, but is not borne out in practice, as the angles should be the same, to do which would be almost impossible, and too expensive, as special machines for this especial purpose would have to be made.

Fig. 5 shows a simple type, and at the same time one that constantly tends to increase and keep tight the steam joint. As the sides in contact with the cylinder walls wear away, the center ring *b* forces the other two, *a* and *d*, away from it and outward and on equal angles in the same direction, giving them four steam joints always under all conditions. A steel expansion ring may be placed under ring *b*, but is not absolutely essential. A flat steel spring is preferable to the one shown in the drawing.

Rings of this type will almost wear away before giving trouble from leakage, beside having the advantage of being easily duplicated and replaced in ordinary shops and at short notice. THE OLD MAN.

### Conical Cam Rollers.

*Editor American Machinist:*

In the AMERICAN MACHINIST for September 15th, in an article on "Cam Movement," s shown a construction so near right as to be absolutely wrong. The cam and roller illustrated would be mutually destructive, for the reason that the cylindrical roller is turned about its axis by frictional contact with a surface whose points are not moving at a uniform velocity. It is obvious that the top of the cam groove *T T*, Fig. 1, will move faster than the bottom *B B*. Hence there must be a grinding action between the driving side of the groove and the cylindrical roller *R*.

The same criticism is applicable to the cam and roller shown on page 5 of your issue of October 14th. The correct construction of such movements would be in accordance with principles illustrated by Fig. 2, the roller *R* being a frustum of a cone whose vertex is in the axis of the cam at *A*.

The error in design pointed out is a very common one, and is found illustrated in many works on mechanics without any mention of its imperfect action.

While I have no doubt that the correct construction has been employed by a great many designers, I have never seen it illustrated in any work on technology, or in actual use save in machinery of my own design. W. F. DURFEE.

### Indicator Cards.

*Editor American Machinist:*

In your issue of October 20th, Mr. A. F. Kefflo asks me to send diagrams from engines with steam valves set without lap.

No. 1 is from a Corliss engine, 30x60, running 56 revolutions. This is the old pattern that was designed and built years ago, when the speed of engines was much lower than now, and the exhaust ports are too small, as shown by the card. This engine has been in use 10 years, some of the time night and day, with no repairs to piston or valves.

No. 2 is from a Harris engine, 28x60, running 52 revolutions. This has been in use 20 years and the valves turned up once. The wrist plate operating the steam valves broke one morning, and the old wrist plate which controlled all the valves was put on, driven by the steam eccentric, until we could get another steam wrist plate.

I enclose No. 3 as a curiosity taken without changing the valves, and eccentric in position to drive the steam valves when using two eccentrics.

These engines drive brass rolling-mills, which is uneven and hard work, the load varying from nothing to an overload.

Mr. Kefflo says that he never had any trouble with Corliss engines but once, and that moving the wrist pins cured it. The writer tried the experiment of putting in eccentric wrist pins that could be moved "all over the lot," but the same trouble remained.

Mr. Kefflo is apprehensive that we must be blowing steam into the exhaust, but the coal pile said $500 per year saved, and the coal pile is the argument that has influence If he would stop and think a moment he would

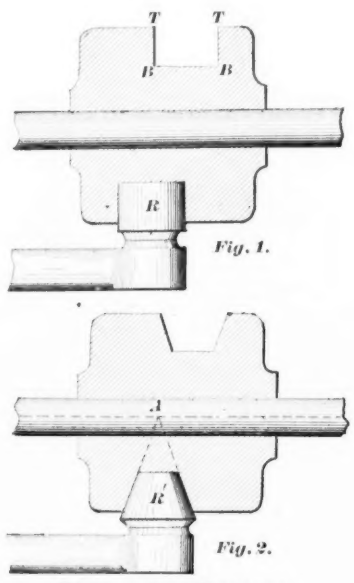



Fig. 1.

Fig. 2.

CONICAL CAM ROLLERS.

see that this was impossible when the cut-off is in action, as the cut-off must act, if at all, at or before half stroke, though when the piston is at its highest speed in the middle of the stroke it will advance quite a distance before the valve is seated. It is this that gives us the chance to increase the range of the governor's action and keep the speed steadier under great changes of load by setting the valves as indicated in the article under criticism.

Even if the steam followed ¾ stroke it could not blow through, as the exhaust does not open until long after that, or until the pressure on the steam side should be released, so that it may not counteract the compression on the other side.

Mr. Kefflo says that there must be a point in every revolution that both valves are open at once. Of course this is impossible with a releasing valve gear. W. E. CRANE.

Waterbury, Conn.

### Link Motion.

*Editor American Machinist:*

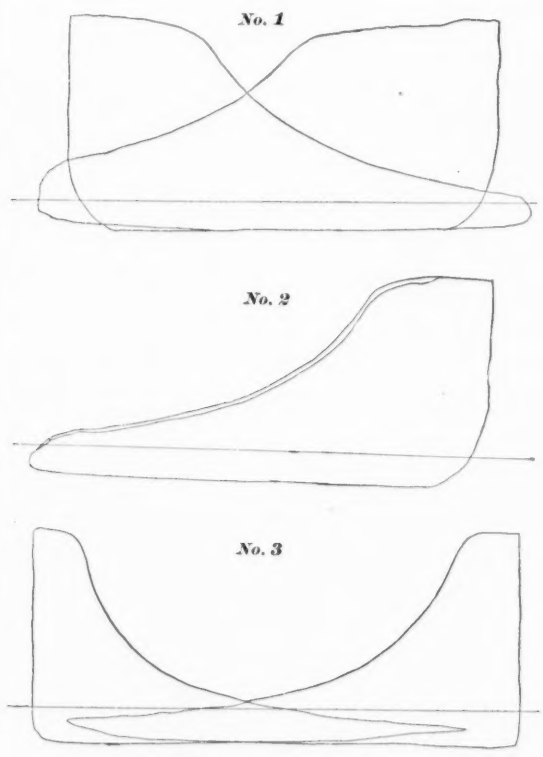
Permit me to say something about the distribution of steam in the cylinders of engines where the link motion valve gear is used. In the August number of the *Locomotive Engineering* there appeared an article headed "Criticism of the Link Motion." The editor's remarks on the article demonstrate that he as well as Mr. Leeds is a warm friend of the link motion. While running a link motion engine at ⅛ stroke cut-off there is an excessive compression, which, it is true, heats the walls of the cylinder so that, when steam is allowed to enter the cylinder, there is no loss of heat which *is* energy by having to heat the cylinder walls with live steam. I have seen numbers of indicator diagrams taken from engines of 24′ piston stroke while cutting off at 8″, and all of them showed that the pressure of steam in the cylinder began to diminish shortly after the piston started from the dead center, owing to the contracted port opening an engine has while cutting off at ⅛ stroke with link motion, even after the cylinder has been warmed by compression. This compression also serves to cushion the reciprocating parts of the engine; but while heating the cylinder and cushioning the reciprocating parts by compression an engine has a great resistance to overcome. The compression in a locomotive cylinder while cutting off at ⅛ stroke is too great and commences too early in the stroke. If there is any rebounding effect at the commencement of the stroke, owing to compression, the indicator has not shown it. In my mind a distribution of steam, such as is produced by the Corliss and Wright valve gears, with the valves adjusted to give a little more compression than in stationary practice, would give much better results than link motion. By having a mor liberal port opening for receiving the pressure in the cylinder at the point of cut-off would be nearly as high as the initial pressure, and the live steam admitted through a full-opened port would both heat the cylinder and furnish more energy than steam wire-drawn through a contracted port opening with the cylinder warmed by compression, as is the case where link motion is used.

HARRY CORNELL.

### Large vs. Small Driving Wheels—Foreign Tools and Machinery—Hard Copper.

*Editor American Machinist:*

Mr. Crane says he does not understand what I mean when I state that a small wheel gives a locomotive more tractive power than a large one, and goes on to say the large wheel will give as much traction if it has a proportionately large cylinder to turn it. Quite so, and this surely was the only way my letter could fairly have been read by an engineer. But the large wheel will not surely pull a larger load than a small one by reason of any more surface contact with the rail. What has surface contact to do with the adhesion anyhow? If any difference does exist, will not the advantage be with the smaller wheel, which sinks deeper into the rail surface? The reason I stated that Americans are building larger wheels now than formerly was simply that my American papers practically state this is so—such papers as the AMERICAN MACHINIST and *Railroad Gazette*, for example, in one of which it was recently stated that so good had been the results of an additional 6′ diameter to the wheels of the locomotives hauling the Empire State express that a further and second addition of 6′ had been decided upon, and




INDICATOR CARDS.

I think the evidence generally is to the effect that for fast traffic my statement was true. That for 20 years the New York & New Haven used a 74″ wheel has no special bearing on the question.

Over thirty years ago the Great Eastern was built on the Thames, of a tonnage far in excess of the biggest steamer afloat to-day, or even intended, and yet this fact does not render untrue the statement that the size of steamers is growing steadily.

Is not the above express to be shortly engined by an 84′ coupled?

Now as to the exhaust getting in the way, Mr. Crane says it does not. Perhaps he will furnish us a few diagrams from some of the engines he names at high speeds, when we can all see just how much or how little the exhaust does get in the way; and if compound locomotives are to become general, the exhaust of the L. P. cylinder will be found very much in the way unless very different port areas are employed from those found sufficient for high-pressure exhausting.

Mr. Crane is not quite correct in his idea that on this side we prefer to run at 75 miles up-hill and 75 down. If he will refer say to the specially fast traffic of 1888 he will find that the heavy Beattock incline was surmounted at about 45, and the G. N. R'y ran regularly on the level at 72, but even these engines with 97½ wheels only have cylinders 18¼″x28″. What I do maintain is that there ought to be reason why a locomotive with a large wheel should not make as good a record as it does in this country. Our passenger trains are as heavy, it is now said, as are American trains. I do not refer to way trains, but to heavy express work; and if it be true, as some state, that it takes more power to haul a ton in America than it does here, there must be a cause for this, either in car journals, car wheels, or in the road-bed.

I am inclined to think that the greater concentration of load upon the wheels has much to do with it. Cars which in America are carried on a couple of short four-wheel trucks are here carried by longer trucks of six wheels. Where trucks are not used we have shorter cars of forty feet, carried by eight wheels, and short thirty-foot cars on six wheels. In any case we distribute the load on the road-bed, and this reduces that continual running up hill which is the case where the road-bed sinks under the load, and even the best roads and rails do this. In other words, our rails are heavier for the loads they have to carry than are the American rails, for the load on a rail is the weight of one wheel, not the mean load per linear foot of train. The result of our practice is that we require less hauling power, can use larger wheels, economize steam by an earlier cut-off, and run faster. By running faster I don't wish Mr. Crane to understand me to claim we have the fastest 400-miles train, but we have them by scores. The gradual increase of train loads has, however, more than kept pace with engine power, and there is no train in England to-day scheduled so fast as the Great Western Bristol express of over forty years ago. This train regularly ran to Bristol in two hours—118 miles. The engine which did it (one of the class) will be at Chicago next year.

I have to thank "Anti-Brag" for his invitation to call and see him, and I will do so when I go his way. He must not, however, imagine that I am decrying American tools or English tools in order to back up anything German. I merely stated what had come under my observation, for the benefit of other tool makers who cared to consider the fact, and, as I said before, it is far more pleasurable to see a foreigner making a good tool than a bad one. The foreign workman who can make good tools will be paid correspondingly, and if not so paid will go where he can get a better equivalent for his labor. I am aware there has been and is an enormous flood of German rubbish, but it is not many years since the same character attached to all American machinery and tools; and yet see them to day. Further, all German productions are not rubbish, nor have they been for a long time. Evidence of this is seen in the large sale of Schaffer & Budenburg's steam gauges—an article made to suit the English steam user, and now seen in almost any boiler house in Britain. If I have not had to sell German products I have had a good deal to do with buying them in the past, and I am convinced that there is much sound work being done elsewhere than at home, and that it would be folly to shut one's eyes to the fact.

A few years ago I went abroad for some English people in order to see to the

satisfactory completion of a rather extensive order for heavy machinery. The whole of it had been constructed under no nspection, and I had it all in parts and thoroughly overhauled, and have no hesitation in saying that it was fully equal to what could have been obtained anywhere as regards workmanship, while in design there was what may be termed an excellent balance between the extreme of conditions favorable to economy and the extreme of conditions most favorable to all-round handiness or elasticity in range of power and adaptability.

Is it or is it not a fact that the so-called hardened copper of the ancients was an alloy —not simply copper? If so, then we can harden "copper" to-day. It would be interesting to have an analysis of the copper chisel which could cut like any other cold chisel, but one feels doubtful of this hard copper being anything but an alloy, and even then of having the property of cutting like steel. W. H. BOOTH.

### Does It Pay to Re-cut Files?

*Editor American Machinist:*

Every mechanic has more or less use for a file. Among machine shops of any size, the yearly cost of files is sufficiently large to receive special attention as a supply item, and it has been the practice for years to have files, when worn dull, given out to be re-cut, the assumption being that a saving is obtained. Thirty years ago, when files were made by hand exclusively, the amount saved in this way fully warranted the practice. The greater portion of files used then were made by local file makers, and in quantities to suit the customers' needs.

With the advantages derived from the use of machines, which are being constantly improved, the systematic arrangement of operations and buildings, and the making in large and constant quantities, the cost of file making has been reduced more than two-thirds as compared with that of earlier days. The advantage of being able to keep machines and workmen upon one operation and one size of work throughout the year is too apparent to need more than a statement.

It is a well-known fact that, when properly designed, machinery will do more uniform good work than can be obtained by hand labor. The earliest attempts, as in fact some of the latest, at file cutting by machinery, were failures, largely the result of lack of knowledge of what constituted a good file on the part of the inventors, and the facility with which a hand operator could vary his work was a decided advantage upon small lots. To-day, things are different. We are informed that the Nicholson File Co. have facilities for producing between 30,000 and 40,000 files daily, that they make over 3,000 varieties of files, and that they pride themselves upon the promptness with which they are able to fill orders. It should not be difficult to find exactly what one wants in such a stock, and the immense output should give this company at least every facility for making each size in large numbers and at small cost.

The advantage which the large manufacturers of files gain, and the erroneous idea that re-cutting by hand pays, was illustrated in one of the largest engine builders' shops a short time ago. They were buying there new files of the manufacturer, but were having them re-cut when worn, believing they were still, as of old, saving money. The facts showed that on 10-inch flat files they were paying 40 cents, and on 14-inch flat files 72 cents more for re-cut files than for new, and these figures did not include an additional difference of one and a half cents per pound to be had from the sale of the old files as scrap.

The reason for this is apparent when we consider that all the file user can save in re-cut work is the cost of the stock and labor of forging, against which must be placed the facts that the grinding costs two or three times as much as for grinding new bar steel, and that this must be done by hand, as against the grinding by machines; that the cutting and other operations must likewise be done by hand and in small lots, the cutting varying as the skill and condition of the file cutter. The many handlings a file has to go through before completion makes the difference between hand and machine work such that the total cost by machinery (including expense account and profit) is less than that of the labor alone when done by hand.

Whilst there is a great difference between one make of machine files and another as to their efficiency, due to difference in the machinery used, methods and systems, rigidity of inspection, knowledge of business, etc., we believe the day of re-cutting files has passed, as did that of hand-made files some years ago, and that the perfection to which some of the file manufacturers have reduced their business is such as to insure a uniformity of high efficiency product not to be equaled by any hand or individual method. STEPHEN NICHOLSON.

### Cut and Try Methods.

*Editor American Machinist:*

We often hear this remark in the shop: "It makes no difference *how* I do my work, so long as I *do it*, and do it *well*." But it really does make a difference, for the matter of time and the greatest security against mishap are great factors in deciding the best method to use. What I mean by the "cut and try" method is where work is fitted direct; that is, without the use of calipers or other means of measuring except trying the parts together. There are some machinists who do their work in this way whenever there is an opportunity, and there are others who will never think of doing such a thing, except in cases where they fail to find a better way, which are quite rare if a person really tries to find a way to measure correctly.

My advice to every young man who is starting to learn the machinist business is to avoid this "cut and try" method. Use your wits to avoid it, if necessary; learn to measure close, and study to apply measurements to difficult places.

This "cut and try" method, as a general thing, depends upon luck, more than anything else that I can see, for good results.

We sometimes see a man boring a hole to fit the end of a short spindle. The spindle not being heavy, he will, instead of setting calipers, bore, and try the shaft itself. A solid shaft or plug is not a good thing to bore a hole by, for the reason that when the end is brought over the hole it covers it completely, and so there is a very poor chance to decide how much there remains to come out. Some will say a "little" more, meaning to take so little that, if it should prove too much, it will not spoil the job; but sometimes this little has to be taken so many times that, if it does not spoil the job itself, it spoils the profit, which is the reason for doing it at all.

A caliper, or some thin gauge, like the plug end of a "snap gauge," should be used, so that when held to the work will show about what remains to come out. I have seen a man fitting a large crank disk to a steam engine shaft, where he had the disk slung with a crane over the lathe so that he could try it (if he could do such a thing, which I doubt, the hole being straight, and the fit a force fit). He no doubt had some idea in doing this, but would it not have been better if he had directed his schemes to making correct measurements?

I wish now to offer a sample case in which quite a number of men were rather slow in seeing a good way to do a certain piece of work. In Figs. 1 and 2 I show enough of two parts of a machine to enable me to make clear what this was. The taper bolt in Fig. 1 fits into the hole *C* in Fig. 2, the straight part *B* and the head being a driving fit. When the bolt is driven down, so that the head comes in contact with bottom of counter-bore, the sleeve *A* should be so that it can be forced down quite hard on the taper, and at the same time come in solid contact at *D* on lower plate. The way this job had been done for quite a number of years was by the "cut and try" way. The bolt was fitted and driven into its place, then the sleeve (which had been left long for fitting) was tried in its place, and then a "little" taken off; then it was tried in its place again, and a "little" more taken off, and so on, till it was finally worn down to the required place. Sometimes the man would have "bad luck," and the last "little" would be a little too much, in which case the bolt must be taken out and reduced on the taper, or the hole in sleeve must be reamed deeper. There had been quite a number of these machines built, and so the time taken to do this job was pretty well known.

A wandering machinist came along, and did this job quicker than it had ever been done before, although he had never done

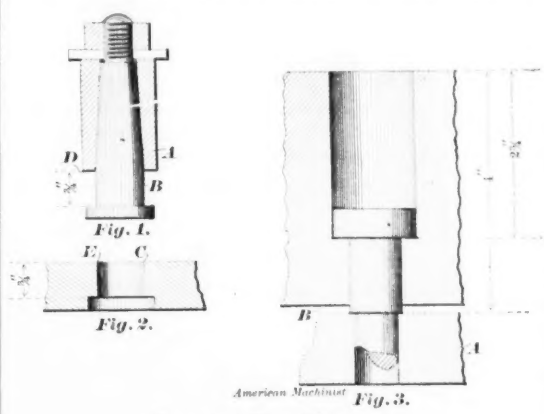


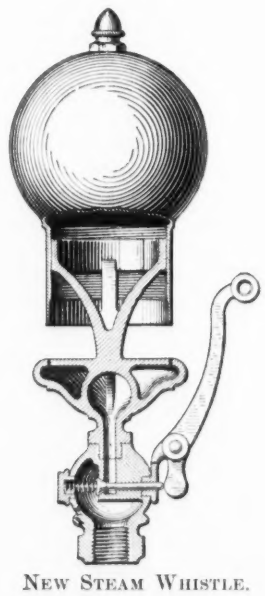

Fig. 1. Fig. 2. Fig. 3.

CUT AND TRY METHODS.

this particular job before in his life, and did it without breaking his suspenders, either.

He commenced the job at the beginning by doing a little thinking first, which he knew to be worth an ocean of thought done afterward. He had a small inch micrometer caliper, which he found would enter the hole *C* in such a way that he could measure accurately the distance from bottom of counterbore through. He set his inside calipers to fit the micrometer, and after forcing the sleeve in its place on the taper bolt, as shown, put the whole in the lathe, and squared off end of sleeve so that the inside calipers showed the distance right between sleeve and head of bolt. I have noticed this wanderer do quite a number of things in a way that I have not seen others use, and it seems that he does not have near so bad "luck" with work trusted to his care as some others do.

In Fig. 3 the bolt is used simply to hold the upper and lower parts together, so that the upper part can turn easily, but no "shake." The space *B* is for clearance, the



NEW STEAM WHISTLE.

parts being fitted together at a part not shown. When the parts are together there is no way of measuring this clearance except through the bolt hole. Many machinists in doing this job would rough measure, making sure that the bolt was long from shoulder to head, then drive the bolt in its place and see how much the head or upper part would raise off its seat, then take the bolt out and try to take this amount off the shoulder; but to be safe they would usually take the bolt out, and put it back quite a number of times. My friend, the wanderer, puts the parts together, and measures with a depth gauge, first from top of upper part down to bottom of counterbore, which we will say is $2\frac{3}{4}''$, then from same place to face of lower part, which we will call $4''$; then he subtracts $2\frac{3}{4}''$ from $4''$, and finds length of bolt from shoulder to head, which he makes to the depth gauge, and he can make it right first time trying.

I have seen large heads fitted to pulley cones by the "cut and try" plan, where a man to be good at it must be more of a pugilist than a machinist. The big fellow got played out, or worked out; at least, he got out after awhile, and a small, new man wanted the work by the job. The boys in the shop predicted that the new man could make about 15 cents per day, if he worked hard; but they were disappointed in this, for what the new man lacked in strength he made up in know how and skill. He started to make caliper fits, and to use the shop—large outside—calipers. Now these outside calipers had a reputation of being "tricky," and the boys thought if this man could make a good caliper fit with them he would do something they had not seen others do. They "kicked" with the new man, just the same as they had been in the habit of doing, but this man had a disposition to fathom mysteries, and it did not take him long to find out and remedy the fault with these calipers. The calipers were heavy, and there was a light spring used about the adjusting feature, as is common. Now they were set in one position and used in another. They would lay them flat on the bench while fitting them to the inside calipers, and then hold them vertically when trying the work, and as the spring was weak the jaws would sag together, and so misrepresent things.

The remedy was a small wooden plug forced under the spring, which served the purpose of shortening, and so stiffening it, and then setting them in the same position they were used in. He did not find he had to work too hard, or that the pay was too small.

There is too much rush about starting a man at work in many shops. A machinist should be allowed a little time to think and plan his work, just the same as the designer or draftsman.

A man cannot just think his way through the world in a machine shop, but a good combination of brain and muscle, with a disposition to work both to advantage, ought to be the right kind. A MECHANIC.

### A New Steam Whistle.

The accompanying illustration is of a new steam whistle, which, as will be perceived, has some new features. To the body of the whistle are cast four curved arms, as shown, which support a threaded ring, which is somewhat larger in diameter than the thread cut inside the bell of the whistle. This ring is divided into four parts by being cut between the arms, the result being that when the bell is screwed onto it it is compressed, and always holds the bell true and firmly in position, at the same time allowing of ready adjustment. The form of bell shown has been found to give a very deep and pleasant tone to the whistle, and to make it audible to a great distance. It will be noticed that the valve is threaded to the whistle, and either can be used separately, if desired. These whistles are made in four sizes, by the Ashley Engineering Co., 136 Liberty street, New York.

Last week we published a paper by Mr. Alfred E. Hunt, of Pittsburgh, on the subject of "Aluminum and its Uses." By mistake this was credited to *Minerals*; the fact being that it is an abstract from, or a condensation of a lecture delivered before the Franklin Institute, of Philadelphia, and published in the Franklin Institute Journal for April.

Many of the employes of a western railroad have decided to quit work because accidents are so numerous as to make railroading too dangerous.

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## Can Machinery Manufacturers Combine?

A good deal may be learned about some of the new trade combinations by looking over the statements made in their advertisements published in the metropolitan newspapers intended to present the advantages of the stocks as investments. The recently formed type founders' combination, for instance, in its advertisement gives the names of 23 firms and companies whose business has been absorbed by the combination. The inventory of the property acquired shows a value of $3,655,128 in machinery and tools. From the statement it can be deduced that a total capital of about $6,200,000 is required to run the business. On this basis $4,000,000 of preferred stock is to be issued and $5,000,000 of common stock, or $9,000,000 in all. On the preferred stock 8 per cent. dividends are first to be paid from the earnings. In spite of the drawbacks which have led to the formation of the combination, the average earnings for some years past have been more than twice the sum needed to pay the dividends on the preferred stock, and earnings of at least $1,200,000 per year are confidently expected under the combination management. It is further stated that at present each founder endeavors to keep pace with the other, thus duplicating plant at great expense. It is declared that nearly all the companies which compose the combination have been long established and "uniformly prosperous." The others are, of course, to be made so by the combination.

In the case of the talked of combination of brass manufacturers one of the prominent movers in the matter has said that a few of the firms concerned have made fair profits, but that the majority of them have not done a satisfactory business.

It will be found, we think, that in most cases of combination of industries there will be some of the establishments that have been making fair profits while others have not been. The reason for this, with few exceptions, is to be found in the fact that some establishments are better equipped than others, and are better managed, and this is just where the significance of the trust movement lies in its relation to machinery builders. One effect of a combination is to relieve the less profitable establishments from all necessity for bringing their equipment up to the standard of efficiency of the better ones, and, once the combination is formed, about all incentive for any of the establishments to improve equipment, to get better machinery or employ higher grades of skill, is removed.

If all productive industries could be formed into trusts, then we should all be on an equal footing, and no one would perhaps have special cause for complaint; but those who will always find it impossible to form any such combination constitute a very large majority of the people, and among these must be classed most manufacturers of machinery. In the case of any comparatively simple product, many of which are used by machinists, a combination is easy, because nothing but price determines the choice of a buyer, but in the case of general machinery there are so many considerations beside mere first cost that will appeal to a prospective buyer, that, supposing any combination to be formed, it could not possibly be a lasting one. A combination among machine tool builders, for instance, is something which any one who knows anything of machine tools and at the same time has made any examination of the elements of strength and weakness of trade combinations would be very apt to believe an impossibility. And, this being the case, it becomes evident that those who build machine tools are at the mercy of those combinations with whom they must have dealings, either as manufacturers or consumers.

And, of course, the farmers, with the great body of those who work for wages, can never form themselves into trusts, their only defense being to do what they may to prevent the formation of trusts by other people—an effort in which it seems to us the vast majority of manufacturers of machinery must be interested, for the reason that trusts must always stand in the way of the adoption of improved machinery, a large proportion of which now finds a market as the direct result of lively competition—a competition which requires that an industrial establishment shall be at least nearly as efficient as its competitors, which competition it is the well-known object and effect of combinations to destroy.

## A Rule That Works Both Ways.

Engineers understand very well the meaning of the old saying, that "A man who is his own lawyer has a fool for a client." Though this saying is open to the suspicion of having been invented by a lawyer for the benefit of lawyers, there is little doubt but that it contains an important truth, whether applied within the strict meaning of the words or in its broader sense, in which it means that he who is his own physician has a fool for a patient, and he who is his own engineer has a fool for a client, etc. Engineers are familiar with the fact that too many men, who would not think of making fools of themselves by becoming their own lawyers or their own physicians, never think of employing a disinterested engineer when they have engineering work to do.

Some things which have come under our notice, however, lead us to think that there are engineers who sometimes forget the value and economy of expert service and advice where anything is to be done involving important interests. Engineers frequently enter into contracts with manufacturers and others for services or supplies of various kinds, and it frequently happens that trouble arises from the fact that the written contract is found, upon being tested in the courts, not to be what the engineer party to it supposed it was. It is quite easy to draw a contract which shall seem to the uninitiated to be very strong, and to leave no loophole through which either party can escape from his obligation in case he should wish to do so, and yet have it, as has proved to be the case many times, so worded as to make it easy to "drive a four-horse team through it." More than one engineer who has supposed that he had an "iron bound contract" with a company, relating to his employment in a responsible position, has found to his sorrow that his continued employment during the term of the contract, his salary, or his allotment of stock, has been made to depend upon some innocent looking provisos or contingencies which leave him utterly without recourse or legal standing in case there is trouble or misunderstanding of any kind.

The best use to which a lawyer can be put is not, as commonly supposed, the getting us out of difficulty when we have gotten into it, but in keeping us from getting into difficulty, and there is probably no better way of having him do this than by having him draw contracts that are real contracts whenever important interests are or are likely to be involved.

## Literary Notes.

MECHANICAL DRAWING, PROGRESSIVE EXERCISES AND PRACTICAL HINTS. For the use of all those who wish to acquire the art, with or without the aid of an instructor. By Charles William MacCord, A. M., Sc. D., Professor of Mechanical Drawing in the Stevens Institute of Technology, Hoboken, N. J.; formerly Chief Draftsman for Captain John Ericsson; author of "Kinematics," "A Practical Treatise on the Slide Valve and Eccentric," and various Monographs on Mechanism.

This work is divided into two parts. The first part contains progressive exercises in mechanical drawing, and embraces the essential features of a course of instruction which the author has successfully pursued for twenty years. A distinction is here made between mechanical drawing and geometrical drawing, the former embracing those methods which admit the use of implements such as T-squares, set squares, etc., in making industrial drawings involving geometrical principles, thereby increasing the facility of the operation, and yet retain all the accuracy for practical purposes. It is this class of drawing on which the author treats, or, in short, purely mechanical drawing according to the above definition; the readers are presumed to have gained from other sources an acquaintance with such geometrical principles as may be made use of in the course of the work. The instructions given as to the use of the pencil, inking in, and in regard to the habits by which accuracy and neatness can be attained, are very valuable, and should be closely studied by all beginners, students, or all who wish to become first-class draftsmen. The exercises in the first chapter are selected and arranged with a view of imparting facility and accuracy in the use of instruments, and for this purpose the author has chosen subjects of an ornamental nature made up of straight lines and circles. In the second chapter the exercises relate to the drawing of non-circular curves, and include the ellipse, parabola, hyperbola, cycloid, epicycloid, hypocycloid, the involute of the circle, spirals, mechanical methods of plotting curves, and the application of some of these curves to the construction of teeth of spur wheels. The remaining six chapters of the first part of the work treat on the principles of projection; objects in inclined positions; of the helix and its application in the drawing of screws; intersection and developments of surfaces; isometrical drawings; Cavalier projections, and pseudo perspective; the spur wheel and the bevel wheel in inclined positions; construction of the close-fitting worm and wheel; construction of the screw propeller; standard sectioning, etc.

The second part of four chapters contains practical hints to draftsmen. The leading object of this part is to explain various modes of representation which the author claims are better, in many cases, than the precise ones of projection. This part was published separately some time ago, and was noticed in our columns at the time of its publication, and so needs no special mention here. The whole forms a valuable work on mechanical drawing, and will fill a large sphere of its own. We believe it to be well adapted for use in schools, technical institutes, and for the use of all who wish to become proficient in the art of mechanical drawing. It is published by John Wiley & Sons, 53 East Tenth street, New York. Price, $4.00.

THE STANDARD ELECTRICAL DICTIONARY. A Popular Dictionary of Words and Terms Used in the Practice of Electric Engineering. By T. O'Conor Sloane, A. M., E. M., Ph. D., author of "Arithmetic of Electricity," "Electricity Simplified," "Electric Toy Making."

The title of this work hardly does it justice—it is more than a dictionary; its character is that of a practical hand-book of reference, in which the terms and subjects are arranged alphabetically, and besides giving the definitions of the terms, much valuable information is added in many cases. Each term or subject is defined once in the text, and where a term is synonymous with one or more others, the definition is given under one title only, and the others appear at the foot of the article as synonyms. For the purpose of finding readily the definition of one of the synonyms, a very complete index is added, by which the page containing the information sought for is given. The work is an excellent one; it is very complete, and is just what is needed. It is published by Norman W. Henley & Co., 150 Nassau street, New York. Price, $3.

THE PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. By Francis B. Crocker, Adjunct Professor of Electrical Engineering, Columbia College, N. Y.; Vice-Pres. of the Amer. Inst. of Electrical Engineers; Pres. of the New York Electrical Society, and Schuyler S. Wheeler, D. Sc., Electrical Expert of the Board of Electrical Control, New York City; Past Vice-Pres. of the Amer. Inst. of Electrical Engineers; Member of American Societies of Civil and Mechanical Engineers.

This is an excellent little book, and one of the best that can be placed in the hands of practical men. It gives simple directions for the practical use and management of dynamos and motors, and such important facts as present themselves in the actual handling of these machines. Although the treatment of the subjects is not much more than a set of directions, it conveys much useful information of a thoroughly practical character, and the whole is arranged for convenience of reference. The subjects considered are: General principles of dynamos and motors. Selecting dynamos and motors. Installing dynamos and motors. Starting, running,

stopping and testing dynamos and motors. Sparking at commutator. Heating in dynamo or motor; general instructions. Heating of armature. Heating of field magnets. Heating of bearings. Noise. Speed too high or low. Motor stops or fails to start. Dynamo fails to generate. The authors do not treat on the construction of dynamos or motors, but simply on their use, running and management, which gives the book a sphere of its own, and will be useful to students and practical men. It is published by D. Van Nostrand Company, 23 Murray and 27 Warren street, New York. Price, $1.

SPON'S TABLES AND MEMORANDA FOR ENGINEERS By J. T. Hurst Mem. Soc Eng.; Mem. Phys. Soc. London; Surveyor War Department; Author of "Architectural Surveyors' Hand-book" "Hurst Tredgold's Carpentry," etc. Eleventh edition.

This little reference book forms a very handy pocket companion; the size of its pages is only 2⅝ inches by 1⅝ inches, and it can easily be carried in a vest pocket. It contains tables which an engineer and architect may have to refer to frequently, and formulas and memoranda for the solution of problems which constantly present themselves in ordinary practice. The book is well worth its price, 40 cents, and with cloth case, 50 cents. It is published by Spon & Chamberlin, 12 Cortlandt street, New York.

# QUESTIONS AND ANSWERS.

*Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.*

(471) H., Evanston, Wyo, writes: Please give me through your columns the dimensions of port openings, lap and lead of valve, for an engine 2½x3 inches; revolutions per minute, 350. *A.*—We should make the steam ports 1x$\frac{3}{16}$ inch; exhaust ports, 1x$\frac{5}{8}$ inch; lap, ¾ inch; lead, $\frac{1}{64}$ inch.

(472) E A. R., Seneca Falls, writes: Kindly answer the following questions: Is the flexible shaft patented? *A.*—Yes. 2. I wish to run a 12 foot boat by an electric motor and batteries. Can I do so and not get too great a load? *A.*—Yes, provided you are satisfied with a moderate speed. Your other question is out of our line.

(473) D. S., Prince's Bay, N. Y., asks: What horse-power will it take to drive a boat at the rate of 30 miles an hour—length of boat, 30 feet; beam, 6 feet? *A.*—That depends much upon the form of the lines; unless these are very fine, you may not be able to get sufficient power in the boat to drive it at this high rate of speed. For correctly designed lines you may need 260 horse-power. Our advice is, unless you have had experience in building fast boats, do not attempt to build a race boat without engaging the services of an engineer who is thoroughly familiar with the business.

(474) W. F. R., Buffalo, N. Y., writes: Please furnish me with the address of the manufacturers of the swiveled blue-print frame, as illustrated by you in one of the issues of the AMERICAN MACHINIST this year. I had the paper, but am unable to find it. The frame is to go out of a side window without a track. *A.*—The frame to which your refer was not published in the current volume; you will find it illustrated in our issue of June 4, 1891. It was designed by and is in use at the works of G. A. Gray Co., Cincinnati, O. We do not know whether they make these for outside parties.

(475) E. X. K., Bound Brook, N. J., writes: Please give formulas for the solution of the following problems. A helical spring of flat steel is twisted to resist a pressure of 200 pounds; what size of steel and number of coils will be required to twist the same spring through an arc of, say 45 degrees, for a given increase of weight? Also give formulas for finding the size of steel and number of coils of a spiral spring to resist the same pressure and under the same conditions as above. *A.*—We cannot find any formulas applicable to the foregoing problems. We see no other way of getting the required data than to resort to actual trials or experiments.

(476) T. C., Detroit, Mich., writes: Kindly inform me where I can purchase a working model of a locomotive, say from 50 to 60 dollars, or what price I could get one for. *A.*—We do not know of any one keeping working models of locomotives for sale, as there is not a sufficient demand for them, and the only way to obtain one, as far as we know, is to get one made. The price will depend much on the accuracy of the model and the workmanship expended upon it. In our opinion you cannot get much of a model for 50 or 60 dollars. We have known a locomotive shop to estimate the price of a first-class and complete working model to a scale of 1½ inch, if we remember rightly, at $2,000.

(477) W. A. R., San Jose, Cal., writes: Please give me a rule for determining the weight of a ball on a safety valve lever, its position, and on what the above depends. Also state what book I can get that will be of service to me—one that contains simple methods. *A.*—You will find this subject fully discussed, and all the necessary rules given, in our issues of August 8, 22, September 5, 1889, and also in answer to Question 227, in our issue of May 19, current volume. Nearly all books on engineering treat on this subject, and in fact many books treating on elementary mechanics contain rules relating to safety valve problems such as given in your question.

(478) A. L., Quebec, Canada, writes: I am building a small compound engine to put in a 33 foot launch, cylinders, 5 and 10 inches diameter, and 6 inches stroke. Please give me the dimensions of a suitable jet condenser. *A.*—The condenser should have a capacity of about half that of the low-pressure cylinder. 2. Also please give diameter of injection pipe, and the size of air pump. Injection pipe about ¾ inch diameter; air pump (single acting) 4 inches diameter, 3 inches stroke. 3. What size of boiler will I need? *A.*—You will need a boiler with about 7 square feet of grate surface, and about 180 square feet of heating surface. A vertical boiler containing this amount of grate and heating surface will be about 42 inches diameter, and 72 inches high.

(479) E. P. L., Waterbury, Conn., writes: Kindly advise me of the best method of taking out and putting in a crank-pin without removing the shaft or crank from its place. Crank-pin 4x6 inches; size of engine, 20x48 inches. *A.*—That depends much on the available room around the pin. There are hydraulic jacks made for the purpose; if space would permit we should use one of them. If a jack cannot be used heat the crank around the pin by means of hot irons, and when the metal around the pin is sufficiently expanded drive the pin out; if the pin under these conditions cannot be driven out it will have to be drilled out, but the new pin may be driven in while the crank is hot, and a good job obtained provided a proper shrinkage fit is given to the pin.

(480) W. B., Columbus, Ohio, asks: When water is formed into steam, and then condensed, does the oxygen leave the water? And would there be more oxygen taken out of the steam of 80-pound pressure than 10-pound pressure? *A.*—No; excepting it is the small amount of oxygen contained in the air which was mechanically mixed with the water and then expelled. 2. How many degrees of heat are there in steam at 10 pounds pressure? *A.*—The temperature of steam at 10 pounds pressure by gauge is 241 degrees Fahr. 3. What book can I get that is simple and accurate, which gives methods for computing the horse-power of engines, pumps, sizes of chimneys, capacity of boilers, etc.—a book that an every-day mechanic may use? *A.*—Any of the engineers' pocket-books may answer your purpose.

(481) F. P. S., N. Y., writes: Please inform me if there is any necessity of having a check valve on a 2 inch delivery pipe from a steam pump used for pumping water in a tank placed on the sixth floor above the pump. *A.*—Yes; the check valve should be placed close to the tank, so that water in the tank can be shut off when the pump is standing still, or when repairs have to be made. 2. Please give me the length of a safety valve lever and the weight on the end of it for a valve ½ inch diameter with 80 pounds pressure. *A.*—Distance from center of fulcrum to center of valve, 1 inch; distance from center of fulcrum to center of weight, 6 inches; weight, about 2½ pounds. 3. What should be the weight of a fly-wheel for a 4x5-inch upright engine? *A.*—For a mean diameter of fly-wheel of 24 inches and 200 revolutions per minute, you will need a fly wheel of about 160 pounds. For faster speeds and the same diameter of wheel the weight should be reduced.

(482) D. R., Newport News, Va., writes: I have served my apprenticeship as a boiler maker and am now under instruction as a machinist, as my mind lies more in machinery; I want to be a good mechanic. Kindly acquaint me with the books I should use to further me on in my business. I am working on the floor on marine work in a large ship building yard, and would like to get the theory of marine engineering. Please let me know where to get the books best suited for my case, and also the price I would likely have to pay for them. *A.*—We have given a course for home study, with a list of suitable books, in the article on "What to Study and How to Study," in our issue of February 19, 1891. This course we believe to be a good one for you to follow. You need not get all the books at once; get what you need as you progress. The addresses of the publishers of these books are given in answer to Question 380, in our issue of August 20, 1891. It seems to us that any good bookseller in your vicinity can get any of these books for you, and he should also be able to give the price before you order them. You will also find addresses of dealers in scientific works in our advertising columns, who will be pleased to send you a catalogue containing the prices of books.

(483) F. G. S., New York, writes: Our building is fitted up with the B. F. Sturtevant & Co. hot-air heating system. I am running a Watts Campbell Corliss engine, 4-inch exhaust, and one Armington & Sims; also 4 inch exhaust, and one Sturtevant engine 1½-inch exhaust. The engine for driving the blower has a 2 inch exhaust; it is placed within 3 feet from the heating coil, and is already connected to the same. The Corliss, Armington & Sims and the Sturtevant engines are about 200 feet away from the coil to be heated by the exhaust. What I wish to know is, if the distance from the engines to coil is not too great, causing the exhaust to condense before it gets to the place where it can do good? *A.*—The distance is greater than desirable, but if the pipes are well covered the loss due to condensation of the exhaust should not amount to much. 2. What size of pipe would you advise for the three engines? And is it necessary to have a back-pressure valve on every one of the exhaust pipes from each engine? *A.*—We should make the main exhaust pipe 6 inches diameter. It is very likely that the exhaust pipes from the engines can be led to main exhaust pipe in such a manner as to make one back pressure valve on the main pipe answer every purpose; in fact, if there are no valves nor other means in the heating system by which the exhaust can be choked you will not need a back pressure valve on any of the exhaust pipes.

(484) J. L. R., Chambersburg, Pa., writes: We inclose an indicator card from a Corliss engine—cylinder, 16x24. It was taken with Tabor indicator, scale of spring, 40; boiler gauge pressure, 75 pounds; 70 revolutions per minute. We figure this card to show that the engine is developing about 35 horse-power. Kindly inform us if this is correct. The engine is supposed to be an 84 horse-power one, and we think that 35 horse power is entirely too little work for it to do. *A.*—You have been very liberal in the computation of the horse-power—we make it 32 only. The engine can and will do more work by increasing the initial pressure in the cylinder. You omitted the atmospheric line on the card, and, therefore, we cannot tell exactly what the initial pressure in the cylinder is, but we should judge it to be not over 50 pounds; this is too much of a reduction from the boiler pressure. The cause of this reduction may be due to throttling, or a steam pipe too small in diameter, or faulty construction of the steam passages Nothing but a close examination of the engine and its connection will reveal the cause. The card shows an excessive negative lead, which also tends to reduce the power of the engine, and besides this the steam is cut off very early in the stroke, which no doubt increases the economy of the fuel, but it will also reduce the power of the engine.

(485) X. Y., Waterloo, N. Y., writes: Suppose a weight be applied to a lever, which has been made fast to the driving shaft of a machine, sufficient to start the machine from a state of rest to that of motion; will this weight be a measure of the force to keep the machine in motion? This has been a subject of discussion between myself and a friend, and the discussion has been brought forward by a desire to test the power required to run a certain machine. We have not the money for buying a dynamometer, and thought if you would answer this through your columns, and at the same time inform us of some simple method of obtaining the measurement of power required to run a machine, it would not only assist us, but also hundreds of your readers, who, when making pulleys to drive their machines, have, for the want of proper knowledge, to do as their grandfathers did before them—make a big guess. *A.*—The weight attached to the lever as you describe cannot be taken as the measure of the force required to run the machine; it is the measure of the force required to overcome the resistance of friction at starting; and the weight which will just keep the machine running at a slow uniform velocity is the measure of the force required to overcome the resistance of friction when in motion, and the latter is generally less than the former. But the power required to run a machine when it is performing useful work will depend on the kind of work it is doing; for instance, some parts of the machine may have to overcome an air resistance, and this may increase nearly with the square of the velocity, and the force necessary to run the machine at a given velocity may be much greater than that which is required to overcome simply the resistance of friction. Take, for instance a locomotive; it takes far less power to start her from rest to motion than to run her at the rate of 60 miles an hour. We know of no other reliable method for determining the power required to drive the machine than by the use of some form of dynamometer. Of course, to apply one requires an expenditure of money, without which we cannot obtain anything, even if it is just a matter of measuring power; indeed, our grandfathers were not exempt from paying or making adequate returns for anything they could use, and they certainly would have used some form of dynamometer if they had had as many as we have now, and would not have resorted to guessing, as this is sometimes a very expensive expedient.


# BUSINESS SPECIALS

*Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.*

Why pay dollars instead of cents? See page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

$10 Countershafts. A. D Pentz, Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

New lists of cutters. Brown & Sharpe.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles Heber Wells, 8 Spruce St., New York.

Drill Presses, with Tapping Attachments. Gould & Eberhardt, Newark, N. J.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Standard Tool Co.'s Twist Drills.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt, Newark, N. J.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves, T. Kieley, 11 W. 13th St., N. Y. Send for des'n.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

Gear Cutters, Auto. Specially adapted for Motor Gears.
Gould & Eberhardt, Newark, N. J.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING Co., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.


## Cogging Wheels—VIII.

BY JOSEPH HORNER.

### REPAIRS.

Repairs to cog-wheels frequently have to be made in the mills with the wheels *in situ*. I propose in this final article to say something about these repairs.

The repairs that have to be done are due to teeth having become worn, or having shrunk and worked loose. And in consequence, if the wheels themselves have very often to remain upon their shafts, the difficulty of the work is greatly enhanced. It is not always convenient to remove a wheel to the workshop for re-cogging, as, for instance, when

other wheels are in the way of its removal, or when, in out-of-the-way country mills, there is a lack of tackle for lifting it out of its place. Unless, however, there are considerable difficulties in the way of the removal of a wheel, it is better to bring it into the shop than to let it be re-cogged in place. In the shops the men can put it into the best possible position for getting round it, the cogs can be turned in the lathe, and the whole of the work done in a good light. The conditions are generally the reverse of these in a mill.

Putting aside the difficulties due to confined situations, one's head being in contact with an overhead beam when working on crown wheels, or seated on a plank, and shrinking into as small a compass as possible when working between a pit-wheel or its wall, or clambering up over its arms and boss with cog and tool is hard. Let us see how best to deal with cases that arise in practice.

Teeth may be worn badly, due to legitimate wear; they may be broken by accident, such as overrunning, or they may be rattling loosely in their mortises, yet otherwise be in workable trim. I will take these cases seriatim.

It is surprising for how long a time mortise wheel cogs will wear under fair work, without fracturing. I have frequently seen them worn until when only of about half their original thickness. But when worn thus, a serging or backlash of the gear, or overrunning due to the wearing back of the shafts, will soon destroy them. It is seldom that teeth wear unequally; that is, though they wear mostly on one side only, dependent on the direction in which the wheels run, one tooth does not wear more quickly than another. So that, as regards the wear due to legitimate use, the whole of the cogs have to be replaced at once in a wheel.

Before the old cogs can be removed, the pins, if pins were used, must be cut off, or driven out. They are generally cut off with a clipping chisel. Wedges, when such are used, whether of iron or wood, must be driven out. After the fastenings are removed there is not usually much difficulty in driving the old cogs back. Sometimes, however, in pit-wheels, and wheels in damp situations, a lot of hard driving and breaking up of the cogs is necessary.

When fitting in the new cogs it is often difficult to drive them tight enough, in consequence of the swing of the hammer being restricted, due to having to work in a confined space. Hence a hammer heavier than usual, with a shorter handle, is the best to use. When the teeth are fitted, then they cannot be turned in the lathe. One of two courses is then open. One is to turn them in a rough fashion in place; another is not to turn them at all, but to cut them with saw and chisel to size after the shanks are fitted, but before they are driven in finally. It is sometimes possible to turn them in place by running the mill-wheel or engine at a suitable speed, and rigging up a piece of quartering or an iron bar against the teeth, to serve as a rest, and using a wood turner's stiff gouge for the work. No fine work, and nothing very accurate can be done in this fashion, but it nevertheless serves the purpose, and does away with a lot of trouble in cutting to shape by hand. In cases where it cannot be done, the teeth are sawn to a template before being driven in.

The pitching out, often by the light of a candle or lamp, cannot be done so well as in the workshop. The wheel can usually be run round to put the pitch circles on. If not, they must be marked tooth by tooth by dividers, with one leg resting on the rim, the other marking the pitch circle. After this, the tooth centers and tooth outlines will be obtained as in any other case, and the teeth will be worked through with gouge and chisel in the best fashion practicable under the circumstances.

As regards fractured teeth, there is only one remedy, and that is to replace them entirely. No patching up of a fractured tooth with pieces glued or nailed is possible, because the stress of work will break them again. A small piece broken off the ends of a tooth, or a little off one side, need not necessitate a new tooth. But if the broken area is considerable it is always better to replace the tooth, because if it gives way entirely the probability is that the whole of the teeth may become more or less stripped, and ruined. So that it is injudicious to let broken cogs remain in place.

Of course, such cogs have always to be fitted while the wheel is *in situ*. They must be sawn to length before being driven in, and their centers pricked off from the contiguous teeth, and their outlines struck to suit; and, if the other cogs are worn, the new ones also must be cut to the same size.

Lastly, there is the loosening of cogs in consequence of shrinkages. This is not so apt to occur in damp country mills as it is in warm workshops and engine rooms. When it does occur, it is not only liable to lead to fracture, but is a nuisance. There is only one course open, and that is to take the cogs out, line up the shanks with canvas or American cloth well daubed with paint, and drive them in again. At first the cog must be kept over to the outside of the mortise opposite to that on which the canvas is put, so that pressure shall not be put on the canvas until the cog is getting nearly down to its seating. Unless this is attended to, the canvas will be partly squeezed and driven out.

### An Extinct Hack-saw.

A reader of the AMERICAN MACHINIST has a hack-saw frame which has the handle arranged to turn the blade into any convenient position, and the blade is tightened by the movement of a lever within the handle. The stud to which the outer end of the blade is attached has no teeth or notches upon it, but is free to take any position, while a flange upon the handle locks by means of numerous small teeth in any desired position. He declares that this is by far the handiest and best hack saw frame he ever saw, because, in changing the blade from one position to another, it is only necessary to loosen the eccentric lever, turn the blade and tighten the lever again, which is the work of but a moment and can be readily done with one hand. The frame appears to be cheap to make, and he wonders why it is no longer in the market, as he wishes to get several more of them. They are not to be found in New York nor in any of the catalogues of dealers. Can any of our readers tell us who made this frame, and why it is no longer in the market?

### Lectures on the Indicator.

The announcement is made that a course of twelve lectures on Steam Engine Indicators will be given by Professor Peabody, at the Massachusetts Institute of Technology, Boston, Mass., beginning, we believe, Dec. 7. Professor Peabody will undoubtedly treat the subject very completely, and will answer any inquiries as to the course.

The *Chemical Trade Journal* states that the following composition has lately been patented by Mr. A. W. Kerr as a substitute for wood, it also being suitable for making crucibles, retorts and bricks, etc. The composition consists of hydrated silicates of magnesia and alumina, such as talc, kaolin or other clays or clayey loams mixed with sphagnum, peat or the like. The composition is molded into bricks in a special apparatus and then fixed, the peat being consumed and leaving a porous mass. In the making of other articles they are dried in chambers through which the waste hot air from the brick kiln is forced.

Train accidents in the United States for September include 113 collisions, 84 derailments and 6 other accidents, a total of 203, in which 93 persons were killed and 235 injured. Of this number, 74 were passenger trains, in which 21 passengers were killed and 119 wounded. Employes killed were 21, and injured, 110. Trespassers on trains and tracks were killed, 4; injured, 6. Defects of road-bed caused 10 of the accidents, negligence of equipment 28, negligence in operating 70, unforeseen obstructions 9 and unexplained causes 86. The average of accidents per day was 6.77; killed per day, 3.10; injured, 7.83. The average killed per accident was 0.458; injured, 1.157.

W. M. Barr, Philadelphia, Pa., is about to bring out a very comprehensive book on Pumping Machinery. Mr. Barr has had extended experience in this line of work, and from an examination of the manuscript and drawings we have no doubt the book will be the best practical treatise on pumping machinery ever published. It will be properly illustrated with entirely original engravings, having nothing of the trade circular in its composition. It will be sold at a popular price.

The I. P. Morris Co., Philadelphia, Pa., has reprinted in a neat form from "American Foundry Practice," by Thomas D. West, the "One Hundred Items that Apprentices Know and Remember." This is a very decided compliment to the author.

We have mislaid the address of Mr. Albert Kingsbury, who contributed a letter to our issue of Oct. 27, on "Centrifugal Action in Ropes and Belts." Will that gentleman kindly send his address?

The advent of the high-speed engine taught men the advantage of journals and boxes as nearly true as they could be made. Whatever other ends it served, it served this end admirably.

There is a proposition to destroy all the baggage of all immigrants arriving at New York from any cholera-infected districts. Why not make the matter even by destroying the baggage of the cabin passengers?

There is some stir because Japanese are to be imported to work on the Nicaragua Canal, at a wage price of ten dollars per month. No one ever supposed that American laborers would be found working there.

It is said that the Cramps will build the new steamships for the Inman line, which are to compare favorably in every respect with the "City of Paris" and "City of New York."

We have no recollection of saying that railroad accidents are growing less. If so we take it all back. The record of such accidents is getting away ahead of the average.

It is rather odd—but it appears to be true—that a railroad train was delayed for two hours on a western railroad by frogs that covered the track.

We have received several applications for catalogues of technical schools. We do not distribute catalogues. The place to apply for them is at the schools.

## MANUFACTURES.

Pomona, N. J., is to have a new cloth factory.

An iron foundry is to be built at Brownwood, Tex.

The Dixon (Ill.) Knitting Co. will erect a new mill.

A broom factory is to be started at Anniston, Ala., by a stock company.

Water-works are to be constructed in Naperville, Ill., at a cost of $100,000.

It is said that a Chicago firm is going to locate a sugar factory at Lena, Ill.

The Pittsburgh (Pa.) Shoe Co. expect to establish a shoe factory at Jamestown, N. Y.

The brass and iron works at Sandy Hill, N. Y., are building an addition to their works.

The Laona creamery, at Durand, Ill., has been incorporated. The capital stock is $1,000.

A cotton-tie factory is to be established at Houston, Tex., by M. Penniman, of Chattanooga, Tenn., and others.

Messrs. O'Neill and Kuett, silk manufacturers, have broken ground for their new mill at Lake View, N. J.

The mammoth stove works at Aurora, Ill., are being increased by additions half as large as the present plant.

The Grant Anti-friction Steel Ball Company, Fitchburg, Mass., issue a price list of hardened steel balls made at their works.

Another window glass plant will be added at Jeannette, Ill. It is claimed that when completed it will be the largest in the world.

A wrapping-paper-mill will soon be built on the old Fairchild woolen-mill site at Malapardis, N. J. Mr. Walter McEwan is at the head of the movement.

The Cumberland Glass Manufacturing Company at Bridgeton, N. J., recently broke ground for the erection of a large 12-pot flint glass furnace for the manufacture of prescription ware.

The Stewart Co-operative Manufacturing Co. has been organized at Kalamazoo, Mich., with a capital of $250,000. A large factory will be started there for the manufacture of fine soaps and toilet specialties.

The Sussex Electric Light, Water and Power Company has incorporated at Deckertown, N. J., with a capital of $7,000. Incorporators J. D. Simmons, B. W. Decker, H. D. Van Baasbeck, C. A. Wilson and S. M. Young.

C. A. Adams, a paper box manufacturer of Worcester, Mass., is looking over the ground in Skowhegan, Me., and if he finds affairs satisfactory, and can have the work of the Keene shoe factory, he will establish a business there that will employ 50 to 75 hands.

The Columbia Shoe Manufacturing Company, of Haverhill, Mass., is corresponding with the Biddeford (Me.) board of trade, with a view to locating a factory there, contingent upon Biddeford citizens taking $30,000 stock in the enterprise, which is capitalized at $200,000.

A new glass factory is to be started at Richlands, Va., in the early part of next month. Its chief product will be pressed and prescription ware, iron mold and chimneys. The factory is to have 12 pots, and will employ from 65 to 75 expert glass blowers and about 300 hands.

Brazil Foundry and Machine Shops (Crawford & McCrannon), Brazil, Ind., send us a well-arranged and illustrated catalogue of plain engines, hoisting and haulage engines, pumps, etc. There is a good deal of useful information in the catalogue in addition to purely trade matters.

The Oil, Fuel, Heat and Power Company has been incorporated at Camden, N. J., to manufacture the hydro carbon patent burner. Capital, $100,000. Incorporators: H. B. Apple, J. V. Lafferty and William Field, of Philadelphia; J. B. Apple, of Ardmore; and H. C. Hains, of Camden.

The stove foundry of Noyes & Goddard, at Waterville, Maine, was burned recently. The works turned out about 12,000 stoves a year, employing about twenty men, and they will at once be rebuilt on a somewhat larger scale. Architect A. G. Bowie, of Waterville, is already at work on the plans.

The Globe Sewing Machine Company has incorporated. Will manufacture sewing machines in Newark, N. J. The capital stock is $300,600, and the incorporators are George Livingston, Otto Hertman, Samuel Ayers, H. S. Beattie, Louis Hauckhouse and V. C. King, of New York, and T. J. Watkins, of Newark.

The Columbian Steam Pump Company is building a factory for the manufacture of irrigating railroad water tanks and other pumps at St. Paul, Minn. The machine and erecting shops will be 50x150 feet in dimension. Other buildings included in the plant are engine and boiler house, tool house and pattern room.

The following corporations have filed articles of association with the Secretary of State of Michigan recently: Lafayette Mining Co., Ontonagon, Mich., with a capital stock of $500,000; Whitehall Silver and Brass Mfg. Co., Whitehall, Mich., capital, $10,000; Howarth Reversible Sash and Sash Center Co., Detroit, Mich., capital, $20,000.

National Sugar Refining Company, of Trenton, N. J., has incorporated. Capital stock, $750,000. The company will commence business on $445,000. Benjamin H. Lowell, of New York, Nathaniel Tooker and John S. Hawley, of East Orange, are among the incorporators. The company will refine sugar and manufacture syrups at Jersey City.

There is water-works agitation at Braintree, Mass.; Denver, Col.; Grand Haven, Mich.; Niagara Falls, N. Y.; Galveston, Tex.; Granite City, Ill.; Ballard, Wash.; Garfield, Wash.; Bridgewater, So. Dak.; Provincetown, Mass.; Davenport, N. Y.; Hot Springs, So. Dak.; Roann, Ind.; Columbia, Mo.; Mayville, N. Y.; New Wilmington, Pa.

A certificate of the incorporation of the Mechanical Rubber Company was recorded recently at the N. J. County Clerk's office. The incorporators are William Barbour, John P. Townsend, Henry W. Cannon, James B. Ford and David King. The capital stock is $15,000, and the object of the company is the manufacture of india rubber goods.

Messrs. Schwenke, Kirk & Co., 26 Church street, New York City, are putting on the market a new photographic paper for copying tracings, which gives black lines on white ground. After exposure in the printing frame the only treatment required for developing and fixing the image is a plain water bath; no developing chemicals of any kind are needed.

The Tudor Iron Works contemplate the erection of a 12-inch mill, in addition to their present plant,

at East St. Louis, Mo., to employ about 100 men. The building will be fire-proof, 200x100, and the company's mechanics are now beginning the work of construction in a preliminary way. The works are at present fairly well employed, and about 800 men are kept busy full time.

The Eastern Manufacturing Co., South Brewer, Me., whose large pulp-mill is one of the most successful enterprises on the Penobscot, will build a paper-mill early next season. The new mill, for which arrangements are now being made, will contain two large machines, probably 108-inch, and be capable of handling all the pulp of the company's sulphite-mill, which is now turning out about 90 tons a week.

The Hamilton Silk Manufacturing Company has been incorporated, with a capital stock of $25,000, of which $10,000 has been paid in. The stockholders are as follows: Simon Lambert, New York, forty two shares; Henry Nathan, Paterson, eight shares; Isidore Dittenhoefer, Paterson, forty-two shares; Laura Sonneborn, Paterson, seven shares; Isaac S. Lambert, New York, one share; David S. Lambert, Paterson, one share.

United Paper Company, of Paterson, N. J., has incorporated. Capital, $3,000,000, one-half eight per cent. preferred stock redeemable at par after ten years, and one-half common stock. Stockholders, Robert Fulton, of Montclair; Charles F. Gankel, of Middletown, Ohio; Charles W. Avery, of Phœnix, N. Y.; Andrew J. Swart, of Averill Park, N. Y.; Jacob C. Lane, of Elkhart, Ind.; and Elisha M. Fulton, of New York City. The company will manufacture tissue paper.

Each year witnesses an addition of one or more buildings to the mammoth plant of the Cumberland Paper Mills, Westbrook, Maine. Work has been begun on the foundations for two new buildings. One will be an extension to the machine shop, 75x50 feet, two stories. This will be used as a storehouse for mill supplies and offices for the master mechanic, time-keeper and purchasing agent. The other will be 140x50 feet, two stories, to be occupied by calendars.

The Lodge & Shipley Machine Tool Co., of Cincinnati, O., exhibited one of their motor gear lathes at the recent convention of the National Street Railway Association at Cleveland. The lathe attracted considerable attention and accomplished the remarkable performance of turning, boring and squaring a motor gear 23 inches diameter, 4½-inch face, and 3⅜-inch bore, in 17 minutes. This machine is meeting with general favor, not only for motor gear work, but for general machine work.

## Machinists' Supplies and Iron.

NEW YORK, November 5, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14.50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $15 to $15.50 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.25 to $13 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Antimony—The market is firm. We quote L. X., 11¼c. to 11½c.; Cookson's, 11¾c. to 12c.; Hallett's, 10¾c. to 10⅞c.

Copper—The market is firmer. For Lake Copper 11.85c. is asked, but no business is reported at this figure; manufacturers are supplied, and producers having sold large quantities are not eager sellers. Casting Copper is held at 10½c. to 10¾c.

Lead—An easy feeling prevails. The best bid is 3.85c., while 3.90c. is asked.

Lard Oil—Prime City is quoted at 70c. to 72c.; Western on spot at 69c.

Spelter—The market continues quiet and nominal at 4.40c. by the carload for New York delivery.

Tin—The market is easy, business is somewhat restricted. Sales are reported at 20.60c. cash, and 20.75c. for January delivery.

## *WANTED*

*"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

Wanted—Agents to sell calipers, etc.; liberal inducements. E. G. Smith, Columbia, Pa.

Mechanical draftsman, two years prac. exp., is open for engagement. L., AMERICAN MACHINIST.

A first-class draftsman, graduated and with experience in steam and general machinery, wants to change position. Box 34, AMERICAN MACHINIST.

A mechanical engineer, experienced in design and construction, desires a situation in New York or immediate vicinity. Address A, Box 1187, N. Y,

Wanted—An experienced draftsman, accustomed to engine and saw-mill machinery. Address Box 465 Vancouver, B. C., Canada.

The supt. and chief eng. to the Goulds Mfg. Co., Seneca Falls, N. Y., is open for engagement Jan. 1, 1893. Address R. H. Aldrich, Seneca Falls, N. Y.

Wanted—Position as chief draftsman or ass't to superintend't, by a mech draftsman who has had 10 years practical experience. Box 33, AM. MACHINIST.

Wanted—Position as sup't or foreman; successful in the systematic mfg. of machine tools, automatic & interchg'ble mach'y. H., Box 310, Florence, Mass.

Wanted Tool Dresser—Young energetic man can obtain good position by addressing Master Mechanic, Swift & Co., Union Stock Yards, Chicago, Ill.

Wanted—Experienced man who understands cutting bevel and spur gears. Address H. W. C., 2324 N. 17th St., Philadelphia.

A young German mech'l engineer (25) wants position in drafting room of a machine factory; screw factory pref'd; 1½ yrs. shop prac. Box 32, AM. MACH.

Wanted—Foreman for mach. shop employing 50 to 100 men in the vicinity of N.Y.; state experience, references and salary. Box 35, AMER. MACHINIST.

Mechanical engineer seeks a position in New York; four years' experience, and first-class references; good draftsman. Graduate, care AM. MACH.

Wanted—Three planer hands, 3 lathe hands, and 2 floor hands, all first-class men. Sioux City Engine Works, Sioux City, Iowa.

Wanted—Foreman for small foundry making machinery castings; one who can make it pay; give refs., and state salary expected. Box 26, AM. MACH.

Wanted—First-class tool maker for brass work manufacturing steam and plumbing goods. Apply to the Ahrens & Ott Mfg. Co., Louisville, Ky.

Desiring to make a change on or about Dec. 1st I would like to secure position as boss planer hand; 12 years experience on light and heavy work. Planer, AMERICAN MACHINIST.

Wanted—Mech. draftsman; must be thor. acquainted with latest designs of printing and folding machinery; steady position to right man; state exp. and where last employed. Box 31, AM. MACH.

Wanted—A draftsman well acquainted with machine tool work and jigs. Address, stating age, nationality, experience, and salary expected, Ferracute Machine Co., Bridgeton, N. J.

Wanted—Position as foundry foreman; heaviest class of engine and machine tool work; No. 1 manager of men; 1st-class reference; strictly sober, etc. M. D., care H. O. Doty, 548 N. 3d St., Hamilton, O.

A young man of twenty wants to work under instructions two years in a job machine shop; will work a month if given a good chance to learn. C. B., AMERICAN MACHINIST.

Wanted—A first-class salesman; must be a prac. mech'c, understand use of indicator, and be thor. familiar with Corliss engine; refs. required. Apply to the Hewes & Phillips Iron Works, Newark, N. J.

1st-class draftsm. wants sit.: general and special mach., power transmissions, tools; thor. technical education; good mathematician. K. K., AM. MACH.

Wanted—Expert planer hand to take charge of planer gang on Corliss engine and heavy work in good shop; good pay to man exp'd in reducing cost. Address Henderson, care AMERICAN MACHINIST.

Wanted—A first-class draftsman competent to take entire charge of our drawing-room. Address, stating experience, and salary required, Sioux City Engine Works, Sioux City, Iowa.

Wanted—Thor. competent and reliable molder to take charge of small shop in Central New York; good opportunity for an energetic young man to build himself up. Address T. H., AM. MACHINIST.

Wanted—A 1st-class tool maker; one who is familiar with jigs and the duplication of parts; our shop is devoted exclusively to the mfg. of automatic eng's. J. H. McEwen Mfg. Co., Ridgway, Pa.

Wanted—Position by mechanical draftsman; 15 years experience designing cut-off steam engines with one of the leading steam engine builders in this country; am still employed, but would prefer making a change. Address C. O., AMER. MACHINIST.

Wanted—Mech. draftsman; a graduate with some experience preferred; must be industrious, correct and quick; to such a permanent position is assured; state experience, and wages expected. The Western Gas Construction Co., Fort Wayne, Ind.

Wanted—Foreman for boiler shop employing about 50 men; the applicant must be familiar with the construction of stationary and portable boilers, tanks, etc.; state age, exp., and wages expected. Address, giving refs., Box 494, Titusville, Pa.

Position in charge with live company wanted, by thorough mechanic, experienced in developing light machinery, and patented articles, and building tools for mfg. same; similar position held for past 8 years. Address "Mass," care AM. MACH.

Wanted—A superintendent of foundry in Ohio, 4 tons daily capacity, great variety of moderately heavy castings. About 30 men employed. He must be a 1st-class molder and good manager of men, a man of family, industrious and strictly temperate. Address B. B., AMERICAN MACHINIST.


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Meet all requirements more fully and satisfactorily than any other of its competitors.

INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.

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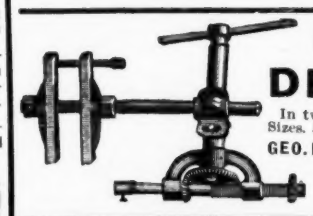
THE HACKNEY HAMMER CO.,
20 Johnson St., CLEVELAND, O.



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STARRETT'S
FINE TOOLS

Warranted Accurate—Best in Workmanship—Latest in design—Finest in Finish—Send for Catalogue.

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LONDON AGENTS: Chas. Churchill & Co., Ltd., 21 Cross St., Finsbury, E. C.

SOFT GRAY IRON CASTINGS.

From ⅛ oz. to 1000 lbs. Small Castings a Specialty. Light machinery wanted to build.

ONTARIO IRON WORKS
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Bradley Hammers.

If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.

BRADLEY & COMPANY, SYRACUSE, N. Y.

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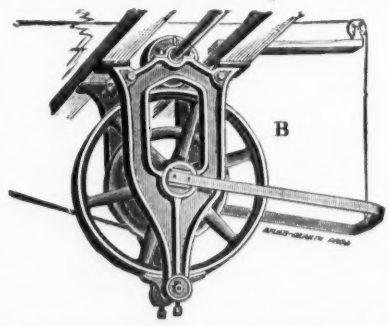
New Patent Whip Hoist.



One hundred and eleven in use at the largest new Hay depots in the World, of N. Y. C. & H. R. R. R. Co., 33d St. & 11th Ave., New York, and Lowell M. Palmer's Docks, North 9th and 10th Sts., Brooklyn, N. Y.

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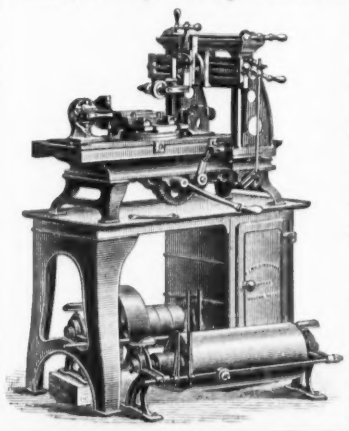
FOR MODEL MAKERS, EXPERIMENTAL WORK, &c.

Has all the Improved Features Usually Found on High Grade Planers, and is Capable of Doing the Best and Finest Work.



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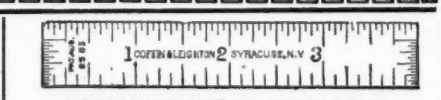

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Makers of Implements for Standard Measurements.

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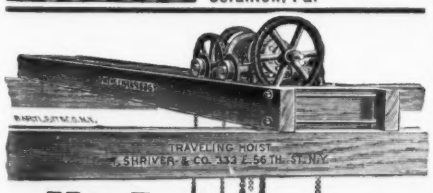


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PRICE OF MACHINE, - - $100.00.
Timber, Bolts, Track Iron for overhead frame, 11.50.
Send for Illustrated Circular, giving full details.

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THE STATES MACHINE CO.,
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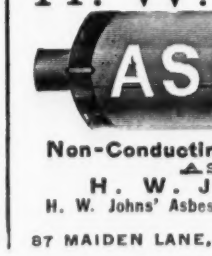

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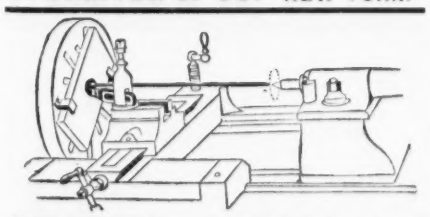

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ASBESTOS
ASBESTOS SECTIONAL PIPE COVERINGS.

Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, etc.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
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87 MAIDEN LANE, N. Y. JERSEY CITY, CHICAGO, PHILADELPHIA, BOSTON, ATLANTA, LONDON.

Wanted—A comp't mach. shop foreman accust'd to mod. prac. on Corliss engines and other engine work; to one that has made an actual success (and none other need apply) a liberal salary will be paid; give present employment, age, and salary expected, and how soon you can report. Box 29, AM. M.

Wanted—An exp'd salesman for N. Y. City and vicinity to exploit and sell Corliss engines; must be comp't to adjust engines, and know when they are prop'y erected, etc.; none but a man of address & good knowledge of steam machinery will meet our views; state experience, age and salary. Address Box 30, AMERICAN MACHINIST.

## ✣ MISCELLANEOUS WANTS ✣

*Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

Cheap 2d-hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Presses, Wire Form'g Mchy. Am. Tool Wks, Clev, O.

Bolt Cutter Heads a Spec'y. Am. Tool Wks., Clev., O.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Gang & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

For Sale—A well-equipped machine shop; price. $4,000. Inquire of H. F. Quickel, Harrisburg, Pa.

We will rent or buy a small machine shop. Write terms, etc., to Shop, care AMERICAN MACHINIST.

**Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R. I.**

Designs & work'g draw's of marine & stationary eng's & boilers, gen'l mach'y, patent drawings. C A. Blomberg, 2262 North 19th St., Philadelphia, Pa.

For Sale—Corliss steam eng. 100 H. P., with boilers, shafting, etc.; a bargain for some one. Address Orrin E. Jones, 416 High St., Providence, R. I.

Wanted—A machine to compress tablets and lozenges, etc.; capacity, 300 lbs. or over per day. Address with price, descrip's & samp's, Jay, AM. MACH.

We will pay 25 cents each for copies of the AMERICAN MACHINIST of December 25, 1886, issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Special, experimental or other light machinery manufactured. Best equipped shop in the West for fine work. Manufacture one of the best hollow spindle bench lathes for the tool room or for manufacturing. Write us. Moseley & Co., Elgin, Ill.

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### LATHES.

All sizes of FLATHER.
" " BLAISDELL.
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One each, 14"x6' and 24"x12' FITCHBURG.
One 78"x15' SELLERS.

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All sizes of WHITCOMB.
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All sizes of PRENTICE.
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One 5' CINCINNATI RADIAL.
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All sizes of HENDEY and EBERHARDT SHAPERS.

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84 in.x72in.x12 ft. Planer 2 Heads, H. & P.
10 ft.x10 ft.x16 ft. Planer. 1 Head.
62 in.x61 in.x9 ft. 2 Heads, Bement.
72 in.x48x30 ft. 3 Heads.
64 in x48 in.x17 ft. do 1 do
54 in.x42 in x24½ ft. do 2 do
42 in x42 in.x16 ft. do 1 do
39 in.x36 in.x12 ft. do 1 do
36 in x38 in.x8 ft. do Powell A1.
30 in.x30 in.x7 & 8 ft. do 1 Head.
26 in.x6 in.x8 ft. do 1 do
25 in.x24 in.x6 ft. do 1 do
22 in.x21 in.x5 ft. do 1 do
98 in.x30 ft. Engine Lathe, Putman.
90 in. x30 ft. Triple Gear Engine Lathe, Ames A1.
50 in.x30 ft. Bed, Triple Geared. New Engine Lathe.
30 in x28 ft. D. W. Pond Shafting Lathe.
32 in.x12, 14, 16, 18 ft. Bed. New Engine do
28 in x12, 14, 16, 18 ft. do do do do
21 in x10, 12 ft. do do do do
20 in.x 7½ & 8 ft. do 2d Hand do do
18 in.x 6, 7 & 8 ft. do New & do do do
17 in.x 8 ft. do do do do
16 in.x 6 & 8 ft. do do do do do
15 in x 6 & 8 ft. do do do do do
14 in.x 6 ft. do do do do do
Car Axle Lathe, Bement.
9 & 14 in. Stroke Slotters.
15, 16, 18, 25 in. Crank Shapers.
20, 24, 26 & 30 in. Geared Shapers.
20, 22 24, 28, 30 & 36 in. Drills.
Bolt Cutters.
1 8ft. Geared Miller. U. V. Co. Good.
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1100 and 3000 lb. Bement Steam Hammer.
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16 in. x 8 ft. Bement, Gib Rest, 12 in. 4-Jaw chuck. Heavy Good Tool. A1 condition.
15 in. x 8 ft. Blaisdell, Rise and Fall Rest, Power Cross Feed. Good as new.
16 in x 6 ft. Hatfield, Rise and Fall Rest, complete. Good as new.
15 in x 6 ft. Blaisdell, Rise and Fall Rest, Chuck and Tools. Good order.
13 in. x 5 ft Pratt & Whitney, Plain Turning, Rise and Fall Rest, Auto Stop to Feed. Good as new.

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42 in. x 36 in. x 12 ft. Gleason, Improved, one Head on Rail. Good as new.
30 in. x 30 in. x 8 ft. Hewes & Phillips one Head, Spiral Geared, Fine heavy Tool. Good as new.
20 in. x 16 in. x 5 ft. Lincoln, with Index Centers. Good order.
18 in. x 22 in. Blaisdell Crank Planer. Good as new.

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24 in Drill Press, Back Geared, Sliding Head, Wheel and Lever Feed. Good as new.
6 Spindle Garvin Drill Press. Good as new.
4 Spindle Pratt & Whitney Drill Press. Good as new.
16 in. Wright Geared Friction Shaper. A1 condition.
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3 No. 2 Brown & Sharpe Screw Machines Auto. Chucks. Wire Feed, complete. A1 condition.
1 Brown & Sharpe Surface Grinder. A1 condition.
1 Whiton 2-Spindle Centering Machine. Good as new.
15 in. x 5 ft. Lodge & Davis, Turret Lathe, 4 Spring Chucks, 3 box tools. Good as new.
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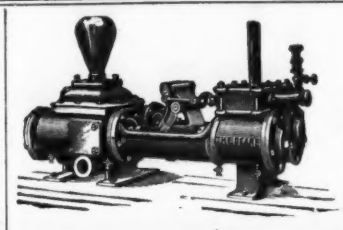

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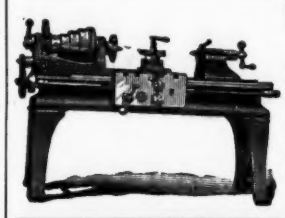

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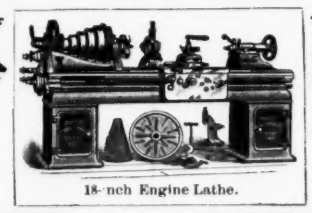

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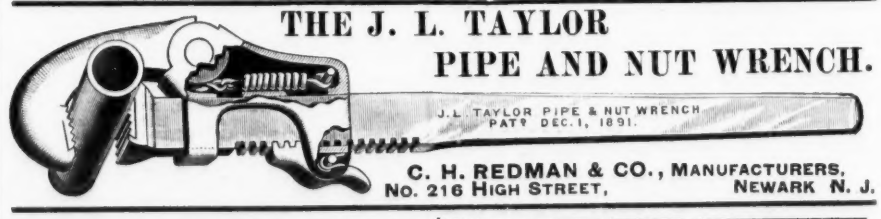


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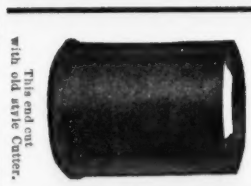

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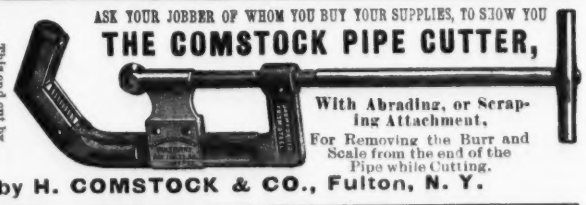

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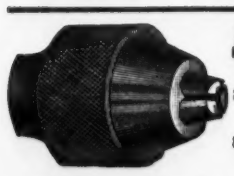

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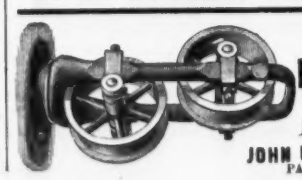

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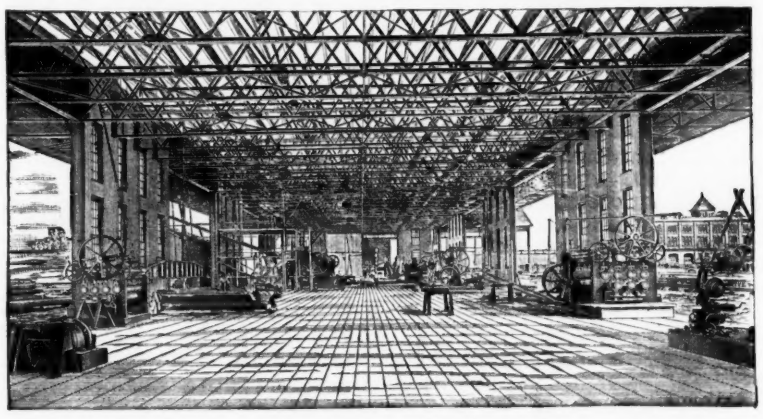

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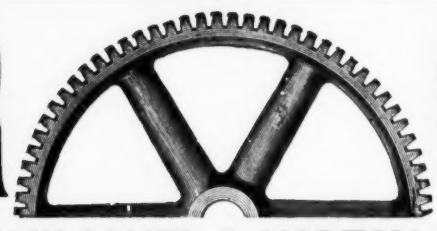

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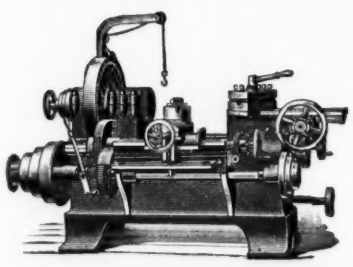

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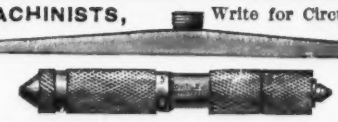

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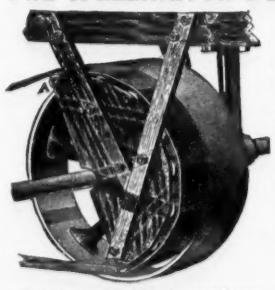

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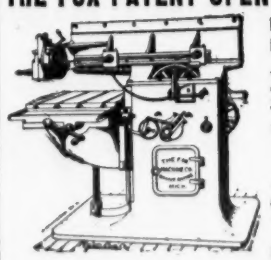

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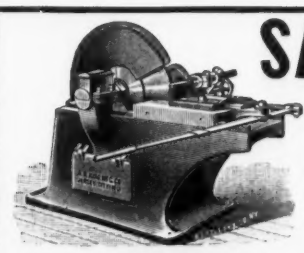

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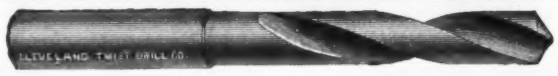


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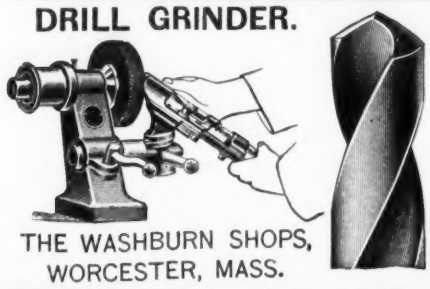

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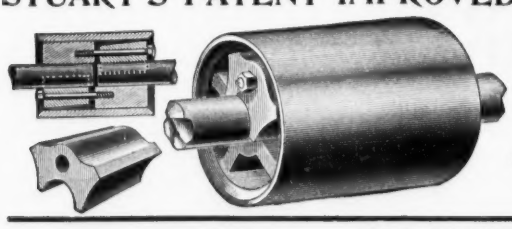

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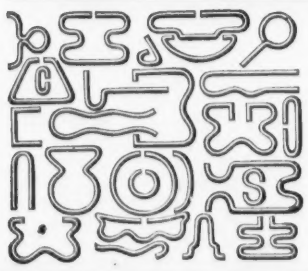

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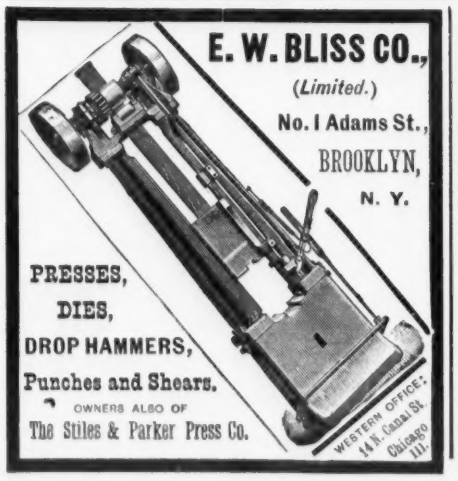


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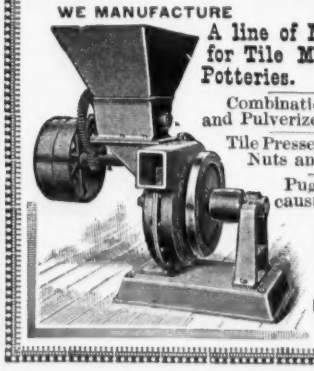

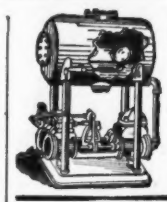

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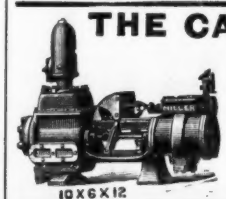
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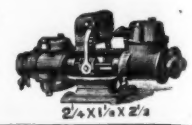
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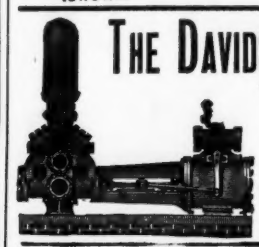

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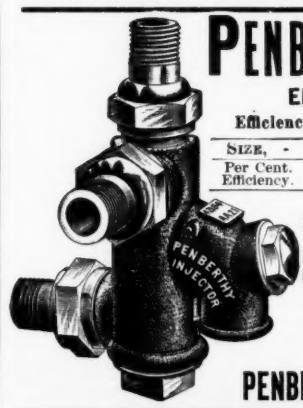

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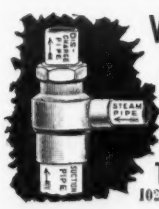

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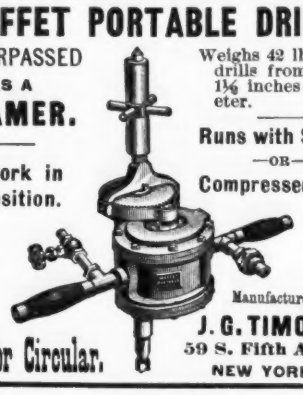

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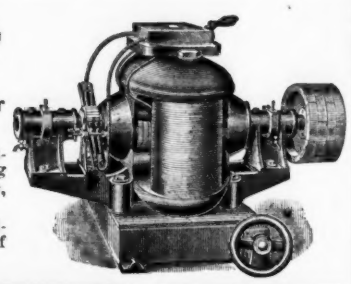

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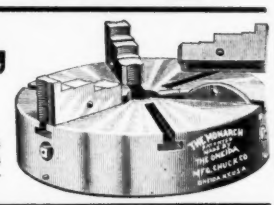

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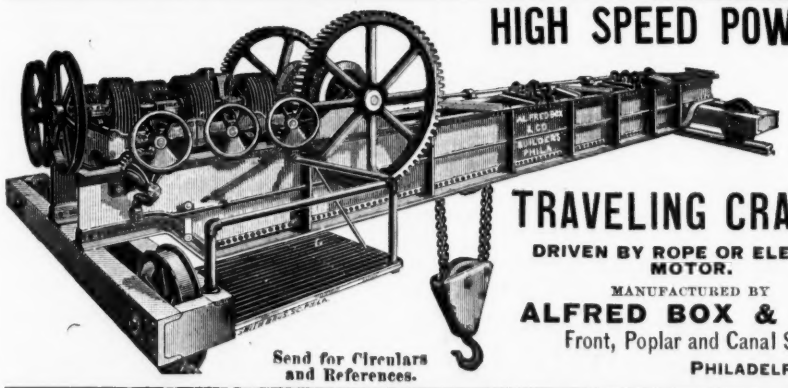

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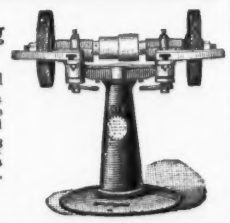

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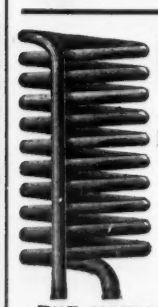

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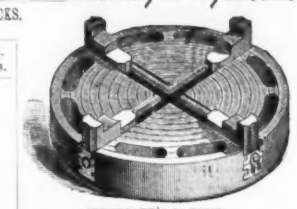

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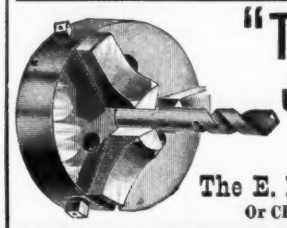

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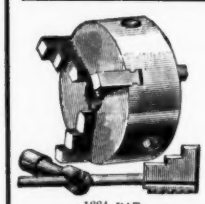

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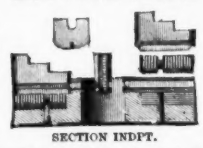

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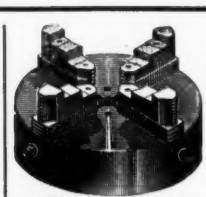

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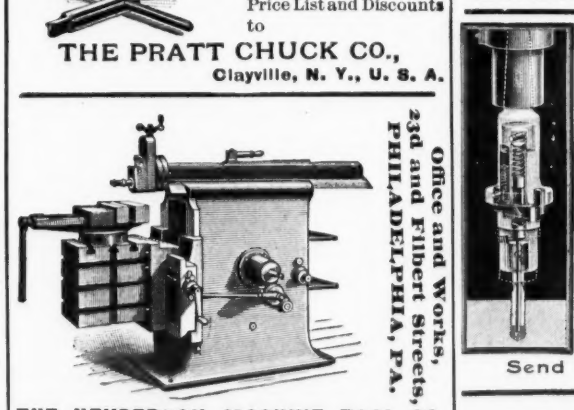

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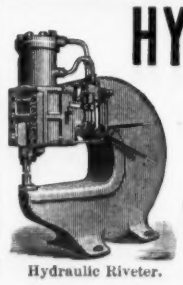

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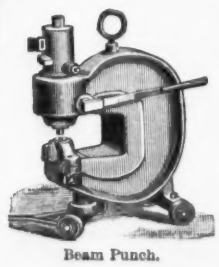

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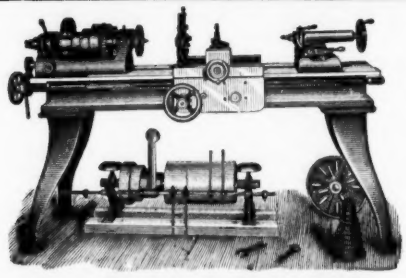

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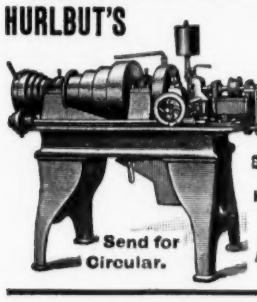


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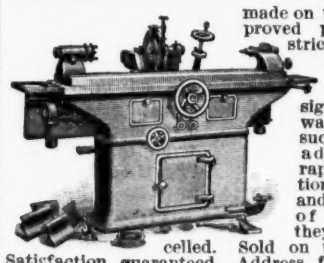

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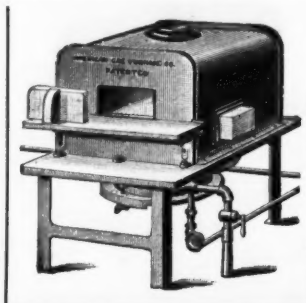

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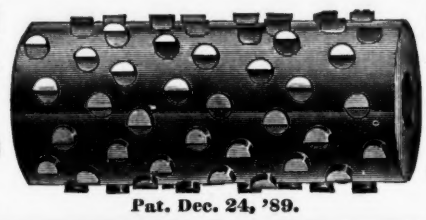

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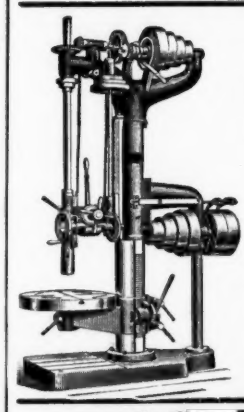
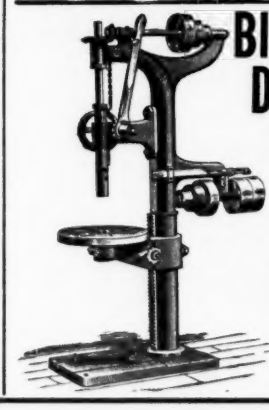


## HAMILTON MACHINE TOOL CO.,

N. F. Cor. Water & Market Sts., Hamilton, Ohio, U. S. A.

MODERN 26" and 32" Back Geared and Power Feed DRILL PRESSES A SPECIALTY.

Correspondence Solicited.



## BICKFORD DRILL CO.,

BUILDERS OF UPRIGHT RADIAL AND UNIVERSAL Radial Drills. Boring & Turning Mills.

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MANUFACTURERS OF VERTICAL MILLING MACHINES, TOOLS AND MACHINERY.

THE BECKER VERTICAL MILLER, No. 3.

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CENTRE, DEPTH, ANGLE,
AND TWIST DRILL GAGE
J WYKE & CO E. BOSTON, MASS
MFR'S FINE MACHINISTS TOOLS.
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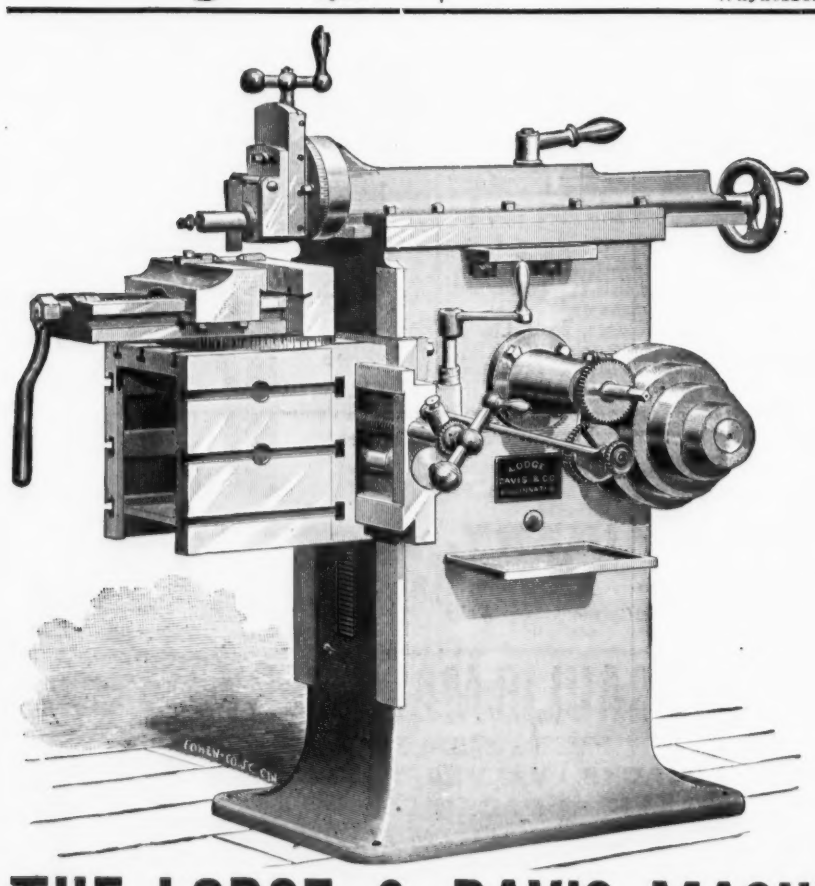
CHAS CHURCHILL & CO., LTD. AGTS.
21 CROSS ST. FINSBURY, LONDON ENG.



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- Stroke can be changed while running.
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- Graduated Swivel Vise.
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Coventry, England, ALFRED HERBERT.

## THE LODGE & DAVIS MACHINE TOOL CO.

Works: CINCINNATI, OHIO.


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Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

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CRANK and GEARED SHAPERS.
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Write for New List, August 1st, 1892.
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SOMETHING NEW.
The Cincinnati Milling Machine Co.,
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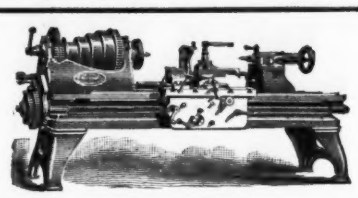

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Planers, Shapers, Drills, Slotters, Etc.

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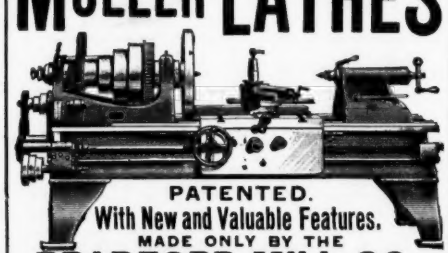

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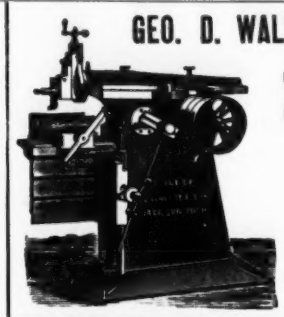

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FOR LIGHT WORK.
Has these Great Advantages: The speed can be instantly changed from 0 to 1600 without stopping or shifting belts. Power applied can be graduated to drive with equal safety the smallest or largest drills within its range—a wonderful economy in time and great saving in drill breakage. Send for catalogue.
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CENTER GRINDING MACHINE.
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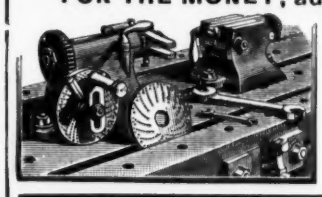

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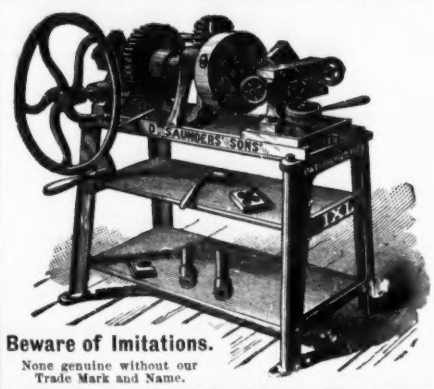
PIPE CUTTING & THREADING MACHINE.

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For Sale by
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Manufacturers of
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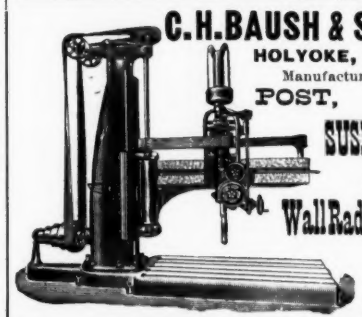
From the smallest to the largest.



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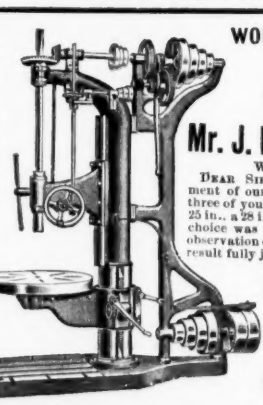

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Yours very truly,
Wheelock Engine Co.
Edward K. Hill, Gen'l Manager.

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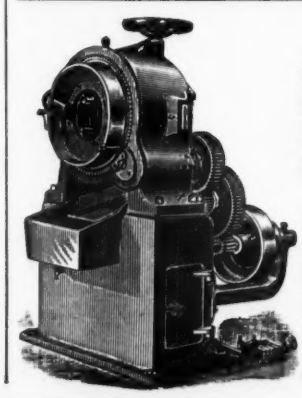

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Pipe Cutting and Threading Machinery,
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W. D. FORBES & CO.,
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FINE TOOLS.

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New Automatic Solid Die BOLT THREADING AND TAPPING MACHINE.
WE WILL GUARANTEE TO
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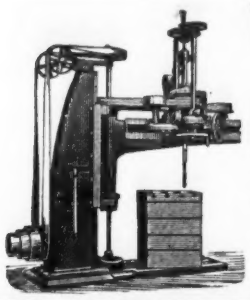

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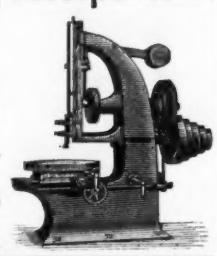

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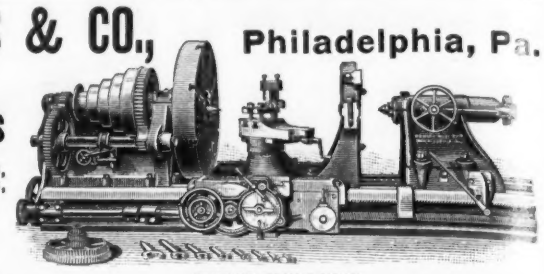

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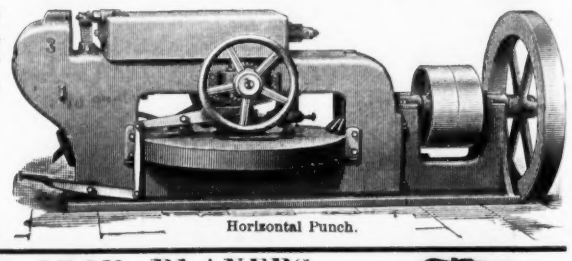
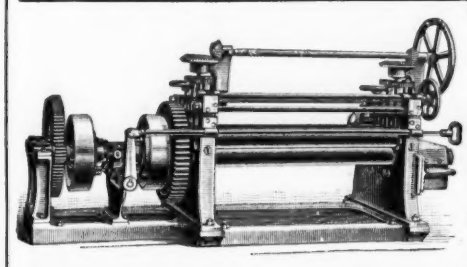


Horizontal Punch.



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CUT SHOWS OUR PLATE STRAIGHTENING ROLLS.

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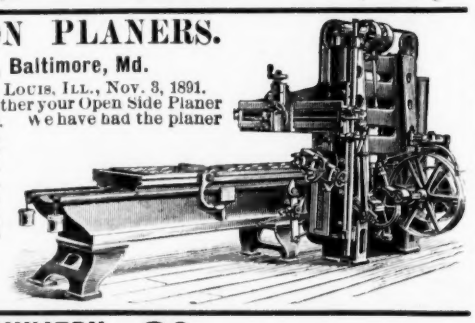
Yours truly,

H. ELLIOT, President,
ELLIOT FROG AND SWITCH CO.



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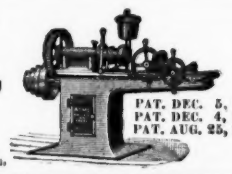

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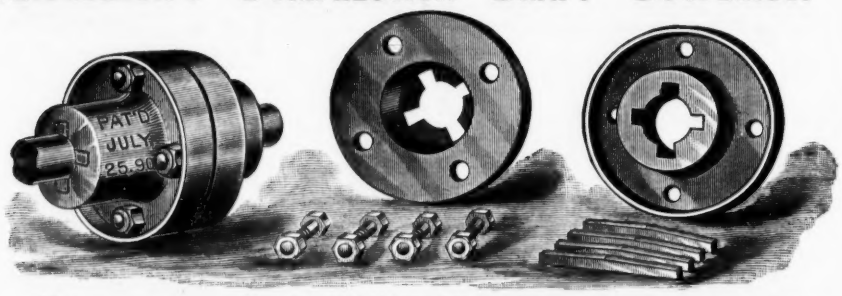


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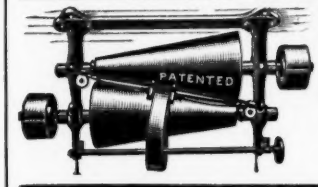


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*the largest,*
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*Feed Drills for ½-inch holes and less.*
*Endless belts.*
*Short belts discarded.*
*Patented Improvements.*
*No belt tension on spindles.*
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GENTL MEN:—We have had one of your raw hide bevel gears running now for over two years in a radial drilling machine where an iron one had broken. It not only has stood where the cast iron did not, but it shows no special evidence of wear.

Very respectfully, (Signed)

THE STRAIGHT LINE ENGINE CO., JOHN E. SWEET, Prest.

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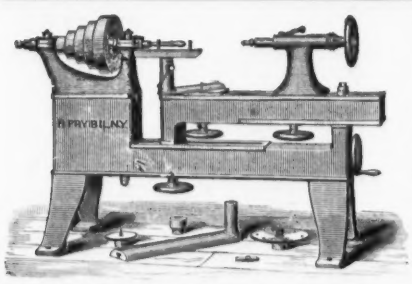


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Made in Two Sizes.

22" Swing or 44" Extended. Weight 1,400 Lbs.
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Will cut through 4-foot hub, through 5-inch hole. Our new centering chuck and setting attachment the work can be set exactly, without the use of a scale or rule. Our new binding attachment saves three-fourths of the time used on any other machine for binding work on. Our machine will cut a key-way and make a key to fit it.

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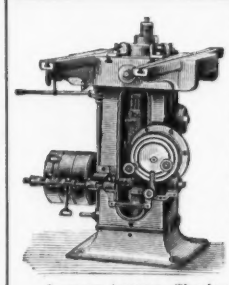

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Rack-Cutting Attachment Key-making Machines.

VALLEY MACHINE CO.

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The Falls Rivet & Machine Co., of Cuyahoga Falls, O., have a Key Seater made by another firm say the Giant is the best Key Seater on the market. The Marinette Iron Works at West Duluth, experienced with other Key Seaters, say the Giant is superior in every respect. L. H. Brightman, Pres. Brightman Machine Co., Cleveland, Ohio, says he is personally familiar with the principal Key Seaters, and that the Giant leads them all.

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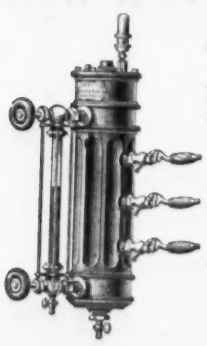

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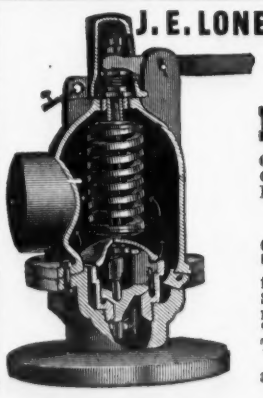

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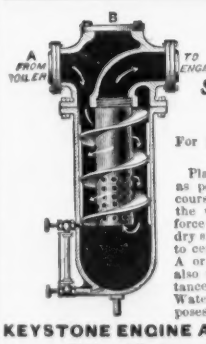


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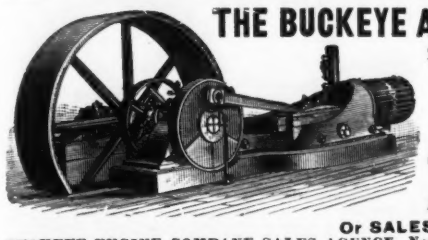

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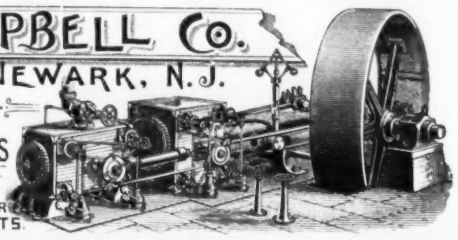

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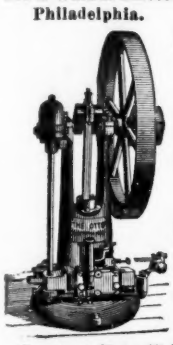

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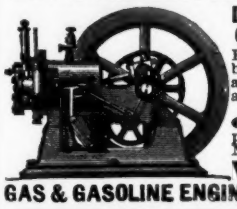

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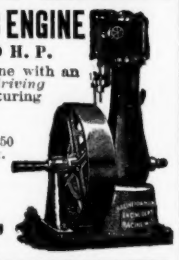

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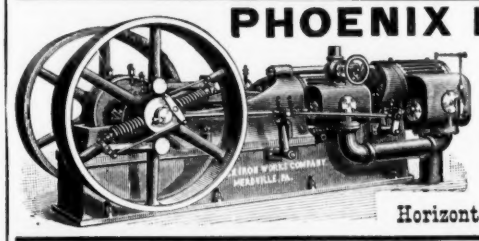

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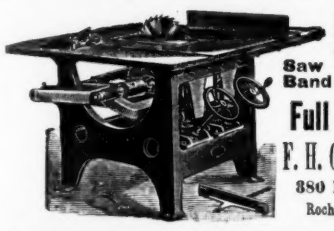

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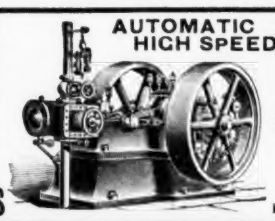

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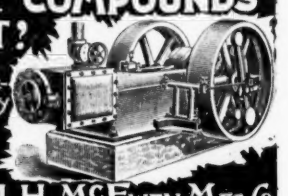

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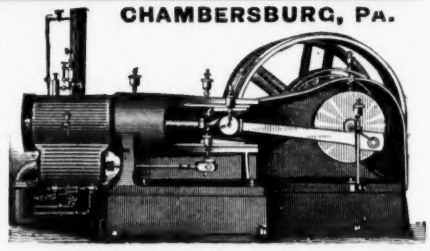

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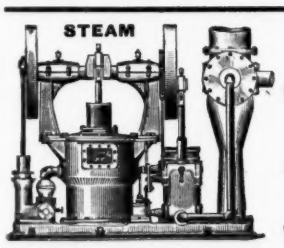

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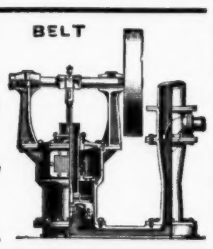

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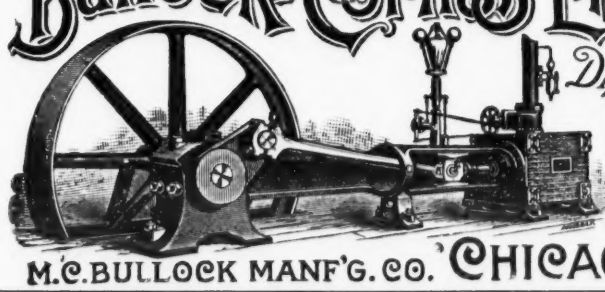

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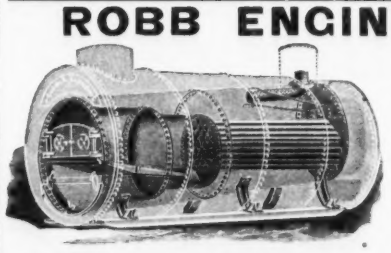

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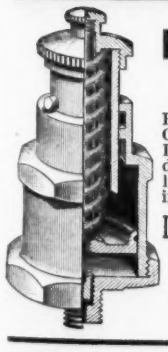

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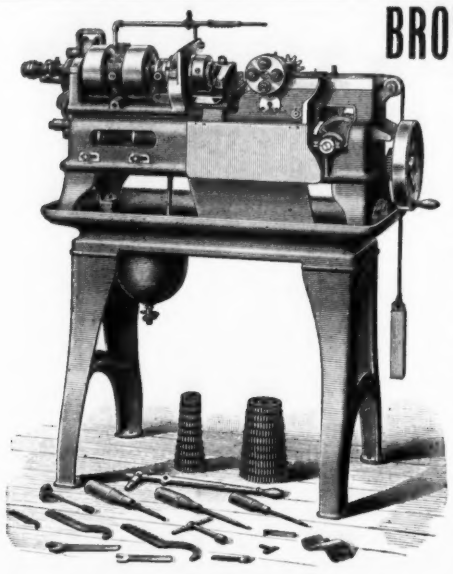

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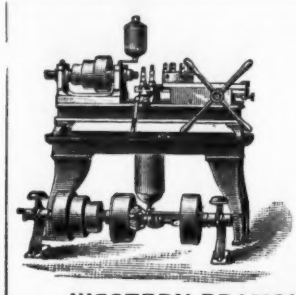

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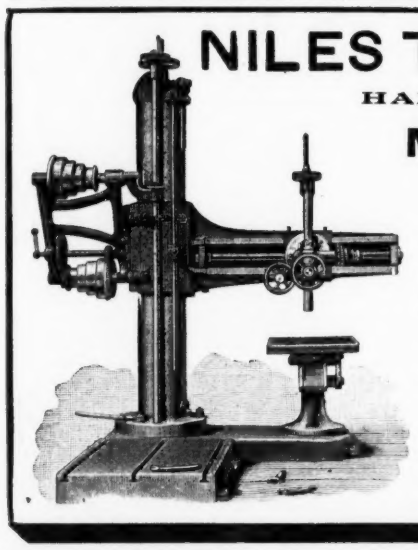

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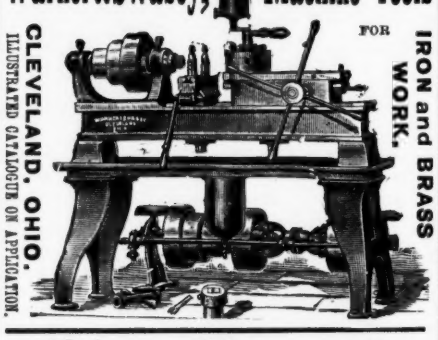

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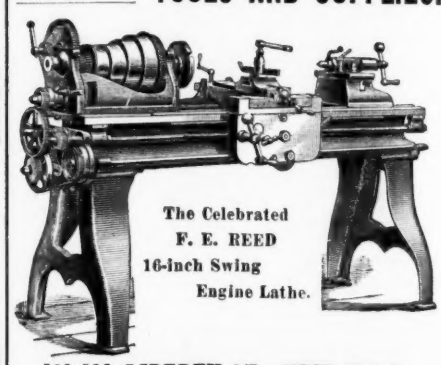

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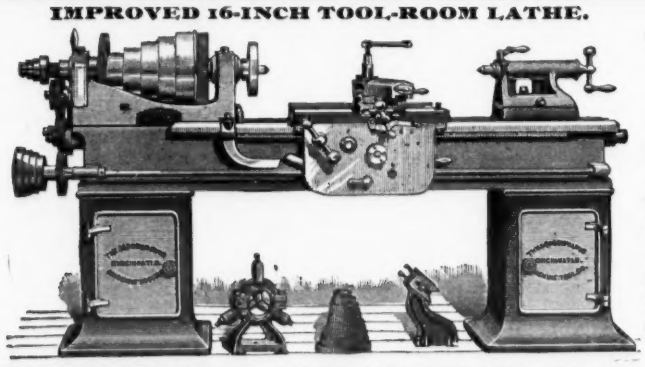

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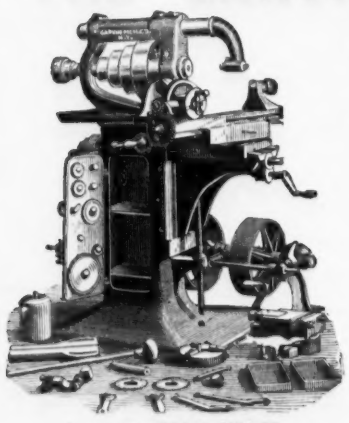

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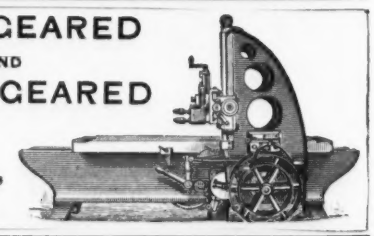

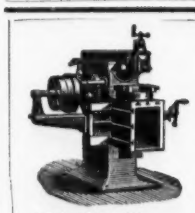

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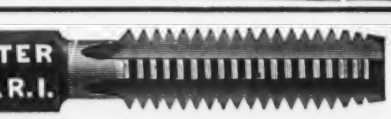

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